NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Agency: Army Corps of Engineers (USACE), New York District

Activity: New York Coastal Storm Risk Management - Beach Nourishment Projects Utilizing the New York Offshore Borrow Areas: Long Beach, Fire Island to Moriches Inlet, East Rockaway, Fire Island to Montauk Point, New York
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Greater Atlantic Regional Fisheries Office

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Approved by: Jennifer Anderson

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1 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of the U.S. Army Corp of Engineers (USACE) conducting individually congressionally authorized Federal projects along the Atlantic Coast of Long Island, New York and sponsored by the New York State Department of Environmental Conservation (NYSDEC) utilizing the New York Offshore Borrow Areas (NYOBA):

- Jones Inlet to East Rockaway Inlet (Long Beach (LB), New York)
- Fire Island to Moriches Inlet, New York (FIMI)
- East Rockaway to Rockaway Inlet, New York (East Rockaway/ER)
- Fire Island to Montauk Point, New York (FIMP)

This Opinion is based on information provided in the Biological Assessment (BA) dated November 14, 2019, past consultations with the USACE New York District (District), in follow-up emails through April 27, 2020, and scientific papers and other sources of information as cited in this Opinion. We will keep a complete administrative record of this consultation at our NMFS Greater Atlantic Regional Fisheries Office. Formal consultation was initiated on April 27, 2020.

2 ESA CONSULTATION HISTORY

Previous individual consultations for each project have resulted in Not Likely to Adversely Affect (NLAA) determinations by you (USACE), and with which we (NMFS) have concurred.

<u>Jones Inlet to East Rockaway Inlet (Long Beach, New York, (LB))</u>

On August 5, 2015, we received a letter from the District requesting concurrence on their determination that the Coastal Storm Risk Management Project off the Atlantic Coast of Long Island from Jones Inlet to East Rockaway Inlet may affect, but is not likely to adversely affect, any species listed as threatened or endangered by us under the ESA of 1973, as amended. We issued a letter of concurrence on September 16, 2015, concluding the Section 7 informal consultation.

<u>Fire Island to Moriches Inlet, New York (FIMI)</u>

On March 22, 2013, you informed us in a letter that you needed to undertake emergency rehabilitation activities within your Areas of Responsibility affected by Hurricane Sandy. We completed the emergency consultation for this project on April 2, 2013. Under a joint ESA/Magnuson Stevens Act letter dated May 9, 2014, we stated "On March 6, 2014, the New York Corps requested that we append additional emergency actions to be covered under our April 2, 2013 letter to the Corps (pers. communication, Jenine Gallo, New York District Corps of engineers, email dated March 6, 2014). All of these projects fall within the already-exempted ecological boundaries along both the New York and New Jersey Sandy-impacted shorelines identified by project name in the April 2013 letter, however they were not specifically identified by the Corps by name or specific congressional authorization at the time the 2013 letter was written either due to a lack of transparency about the application of the new law (P.L. 113-2 was only recently interpreted by USACE-HQ) and/or due to the identification and/or acceleration of certain reaches or segments of some projects (pers. communication, Jenine Gallo, New York

District Corps of engineers, email dated 3/6/2014)." In an email dated June 17, 2014, we confirmed that the Fire Island to Moriches Inlet project was included in this amendment.

East Rockaway to Rockaway Inlet, New York (East Rockaway/ER)

As referenced above, the same letter of March 22, 2013, also informed us of your need to undertake emergency rehabilitation activities at the East Rockaway site. One of the shoreline restoration/rehabilitation activities involved the East Rockaway Inlet to Rockaway Inlet. We completed the emergency consultation for this project on April 2, 2013.

On January 5, 2017, we received a letter from you requesting concurrence on your determination that the East Rockaway Inlet to Rockaway Inlet project may affect, but is not likely to adversely affect, any species listed as threatened or endangered by us under the ESA of 1973, as amended. We issued a letter of concurrence on January 12, 2017, concluding the Section 7 informal consultation.

Fire Island to Montauk Point, New York (FIMP)

On February 2, 2016, we received a letter from you requesting concurrence on your determination that the Coastal Storm Risk Management Project off of the Atlantic Coast of Long Island from Fire Island to Montauk Point may affect, but is not likely to adversely affect, any species listed as threatened or endangered by us under the ESA of 1973, as amended. NMFS issued a letter of concurrence on March 29, 2016, concluding the Section 7 informal consultation.

We received an email on June 16, 2017, from Tetra Tech regarding the capture of two Atlantic sturgeon near the Shinnecock Inlet. After discussing the project with you, we were informed that the two sturgeon were collected during the USACE-funded post-construction monitoring activities associated with New York State Flood Control and Coastal Emergencies (FCCE) Act - PL 84-99/Disaster Relief Appropriations Act of 2013 and the PL 113-2 Projects; East Rockaway Inlet to Rockaway Inlet (Rockaway Beach) and Jamaica Bay and Fire Island Inlet and Montauk Point, West of Shinnecock Interim Project (WOSI). While we have completed consultation informally on these projects, the project descriptions or effects analysis did not include any post-construction monitoring/sampling, such as trawling, which triggers the need for reinitiation of consultation.

You submitted a biological assessment (BA), along with a request to reinitiate consultation on these four dredging projects on November 14, 2019. You have also submitted additional information per our request through emails up until April 27, 2020. The four proposed projects are needed as a response to the impacts sustained from Hurricane Sandy on October 29, 2012. Because the projects are similar, take place in the same geographic area, and affect the same species similarly, we have determined it would be most efficient to analyze all effects in one consultation. As such, while there are four independent projects considered here (i.e., beach nourishment projects for LB, FIMI, ER, and FIMP – jointly "the federal action" or "the proposed action"), we are producing one Opinion.

Reinitiation of consultation is required and shall be requested by the Federal agency or by us, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation; (c) If a new species is listed or critical habitat designated that may be affected by the identified action, or if a new species is listed or critical habitat designated may be affected by the action. A reinitiation of the consultation will require a new biological opinion that covers all four projects even if only one project meets the reinitiation trigger. Consequently, some projects and/or activities i.e., those that have triggered reinitiation, may need a more thorough effects analysis while other projects and/or activities may just need to be updated based on the work completed and a reduction in the time span covered by the consultation.

We expect that determinations about the scope and effects analysis of any future reinitiation(s) will depend on the cirucumstances associated with the cause for reinitation and be made in cooperation between our agencies.

3 DESCRIPTION OF THE PROPOSED ACTION

This Opinion considers the effects of four beach nourishment projects and biological sampling associated with these projects located in New York: LB, FIMI, ER, and FIMP. These projects include beach nourishment activities throughout their project lives using sand from the New York Offshore Borrow Areas (NYOBA) located between one and four miles offshore of the eastern portion of Long Island, New York, between Coney Island, to the west, and Montauk Point, to the east. As part of several of these projects, construction of structures along the shoreline will also occur. The AOCE New York District Civil Works provides descriptions and projects updates for each project on their website[1].

As described below, each of the four projects have different start dates with varying durations ranging from two to 19 years. If additional beach nourishment is needed after this timeframe, or if dredging is required in other sand borrowing areas not covered under this biological opinion, reinitiation of consultation may be necessary.

In addition to beach nourishment activities, the proposed action includes biological monitoring at the NYOBAs in order to comply with New York State Department of Environmental Conservation's (NYSDEC) aquatic biological monitoring mandates (per Water Quality Certificate Special Conditions). To this end, you have initiated The Atlantic Coast of Long Island Aquatic Biological Monitoring Program (ABM), which is currently supporting biological analyses of aquatic resources for two of the projects under construction (LB, FIMI). The ABM program is expected to be expanded to include biological monitoring of the borrow sites for the other two projects (ER, FIMP) if such monitoring is required.

1 https://www.nan.usace.army.mil/Missions/Civil-Works/Projects-in-New-York/

3.1 Dredging, Beach Nourishment, and Structures

Each project, under separate authorization comprises multiple contracts, utilizing hydraulic cutterhead and medium to large volume hopper dredge equipment to remove sand from the NYOBAs for placement via pipeline on the shoreline. The equipment likely to be utilized for these projects are of similar size and capacity to those used in recent previous hydraulic dredge projects in the region. The exact dredge to be used on a given project depends upon dredge contractor equipment availability at the time of award. According to the USACE, the New York coastline is not a designated area that requires UXO screens, so they do not mandate their use there. The USACE mandates the use of screening of all portholes and other inlets that could intake a small individual so as to permit the ESA observer to inspect these areas, as well as the hopper intake area and baskets for such evidence. Some of the previous dredge projects in the area have used the following hopper dredges:

Table 1. ODESS data showing a sampling of the names and carrying capacities of active hopper dredges that have been used south of Long Island previously (USACE ODESS, accessed November 22, 2019)

Hopper Dredge Name	**Project Start and End Dates**	**Location on Long Island**	**Maximum Bin Capacity (CY)(Dredgepoint)(accessed 11/22/2019)**
Atchafalaya	10/14/1993 – 11/26/1993	Fire Island	1,300
Mermentau	10/14/1993 – 11/26/1993 9/28/1996 – 11/14/1996	Fire Island Jamaica Bay	1,300
B.E. Lindholm	1/15/2004 -1/27/2004	Smith Point	4,000
R.N. Weeks	1/15/2004 -1/27/2004	Smith Point	4,000

Typically, a hydraulic dredge (cutterhead or hopper) is deployed to the offshore borrow area to mine sand. The sand is then either transferred to a secondary pump barge from which a pipeline laid along the bottom of the seafloor pumps sand to the eroded beach, or the sand is pumped directly from the hydraulic dredge via pipeline. The NYOBA is located between one and four miles offshore of the eastern shoreline of Long Island, New York between Coney Island and Montauk Point along and between the 20’ to 70’ foot contour (Figures 1-5). Discrete areas of the borrow site shall be tested for appropriate grain size to determine if the material is suitable for beach nourishment purposes. Each project description is presented below.

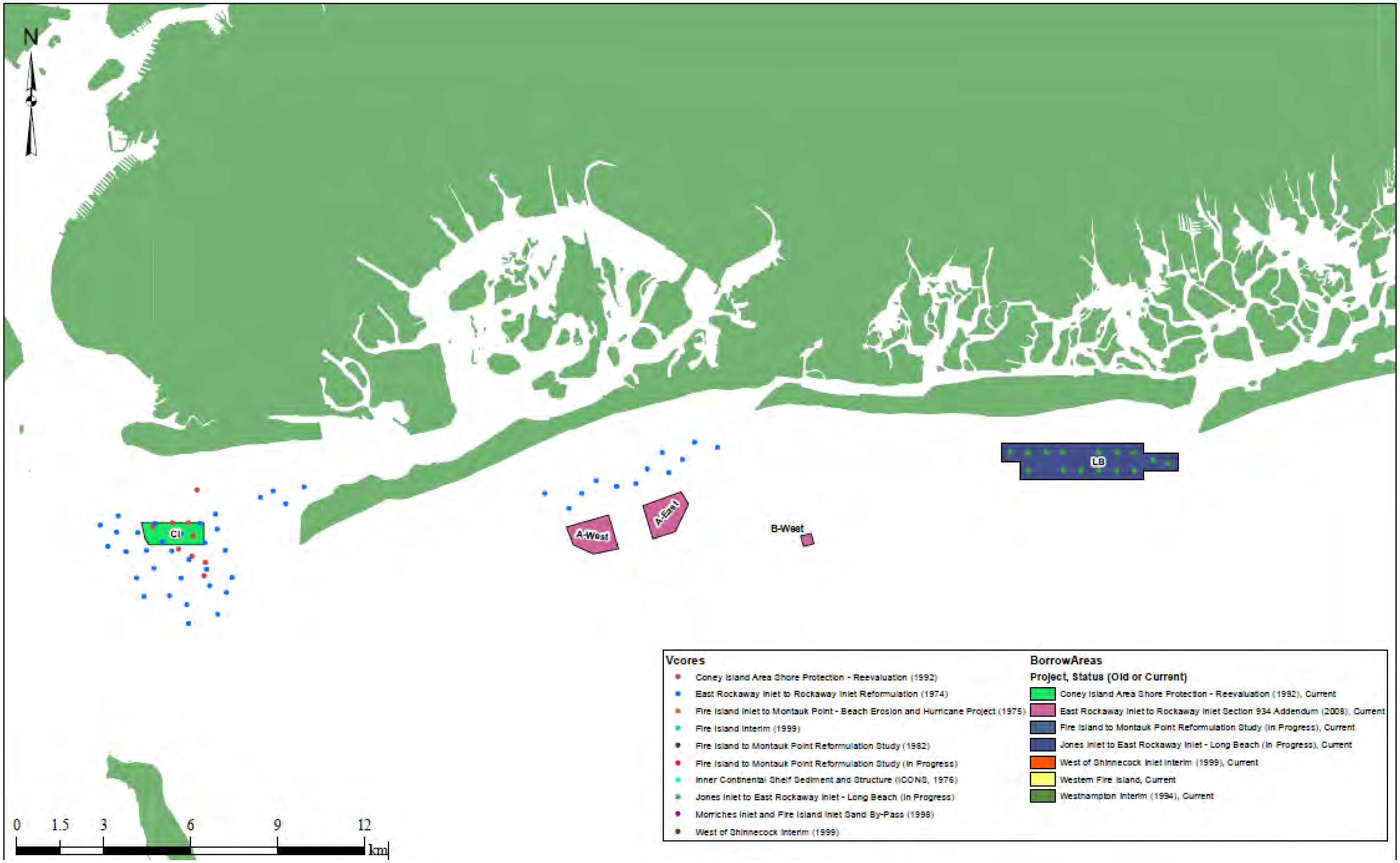

Figure 1. Active borrow sites for Coney Island, Rockaway, and Long Beach

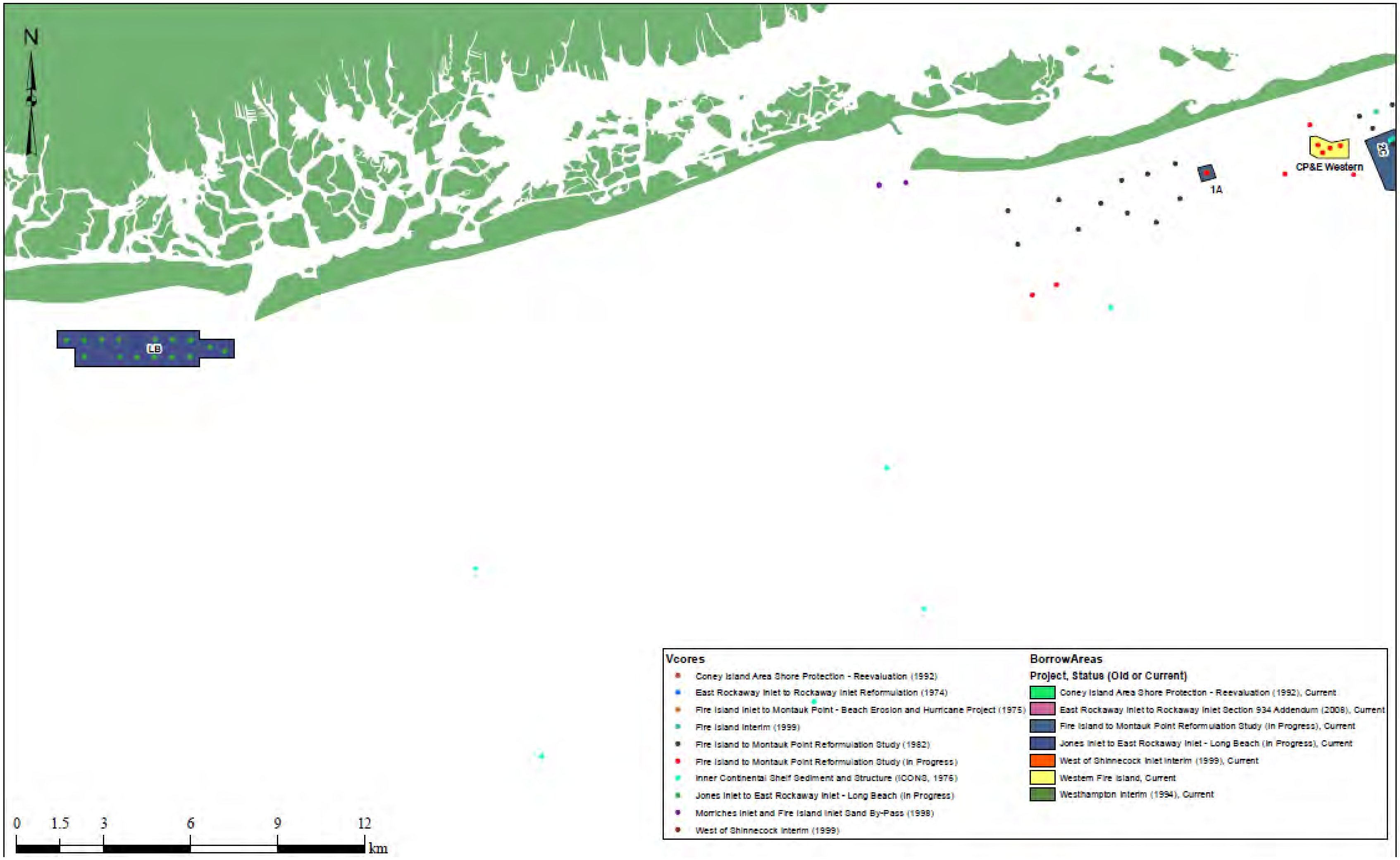

Figure 2. Active borrow Sites for Jones Beach

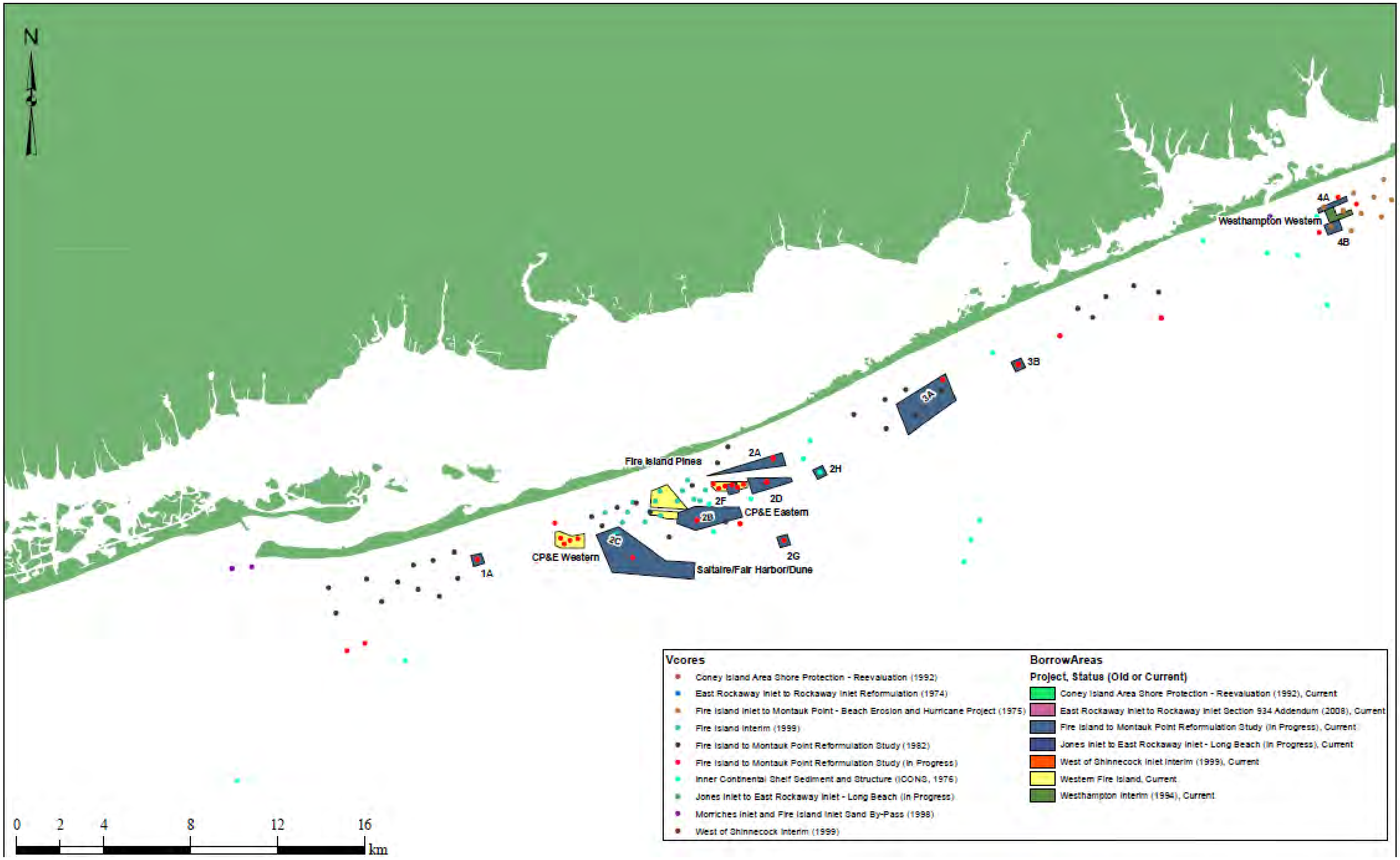

Figure 3. Active borrow sites for Fire Island

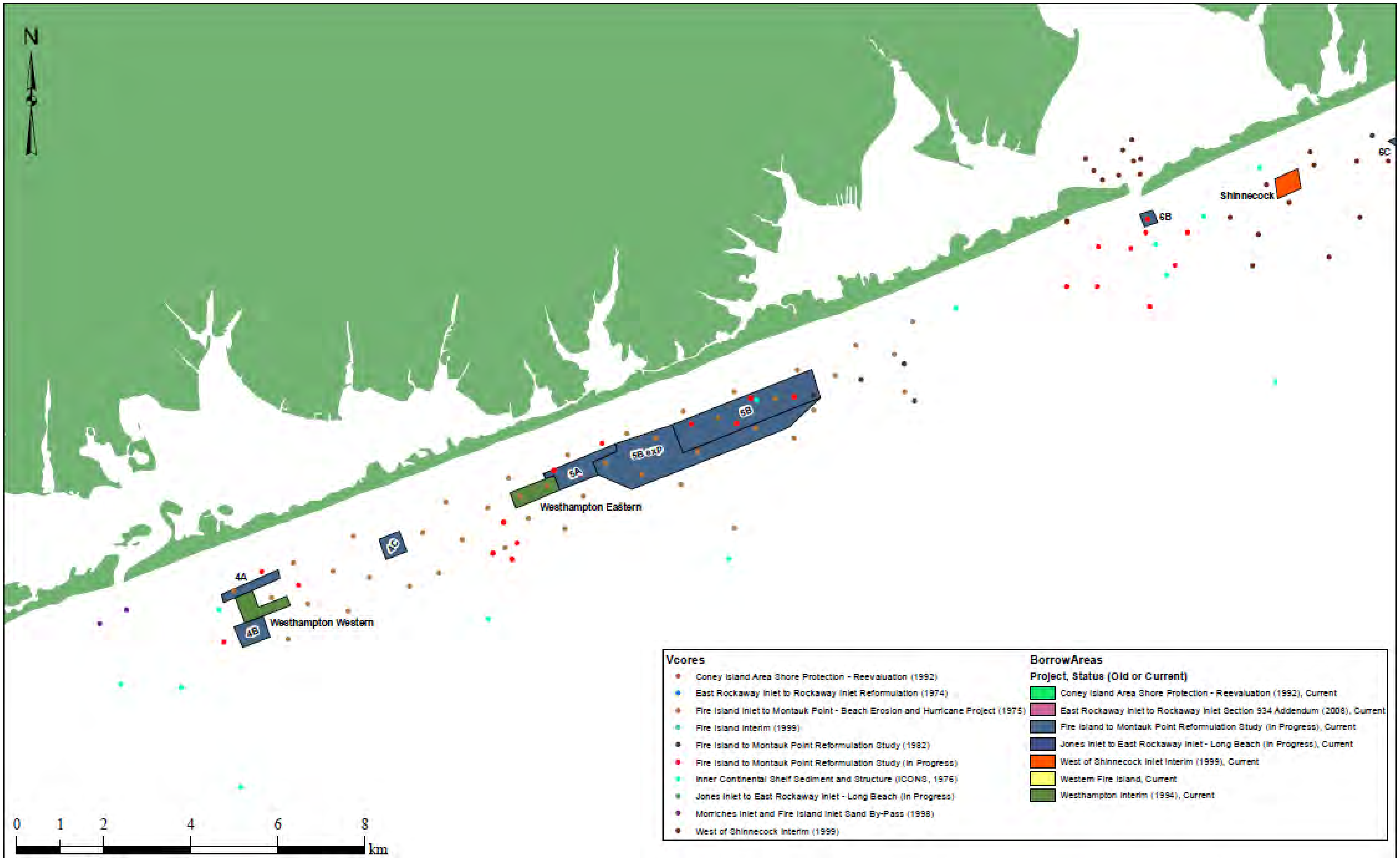

Figure 4. Active borrow sites for Westhampton

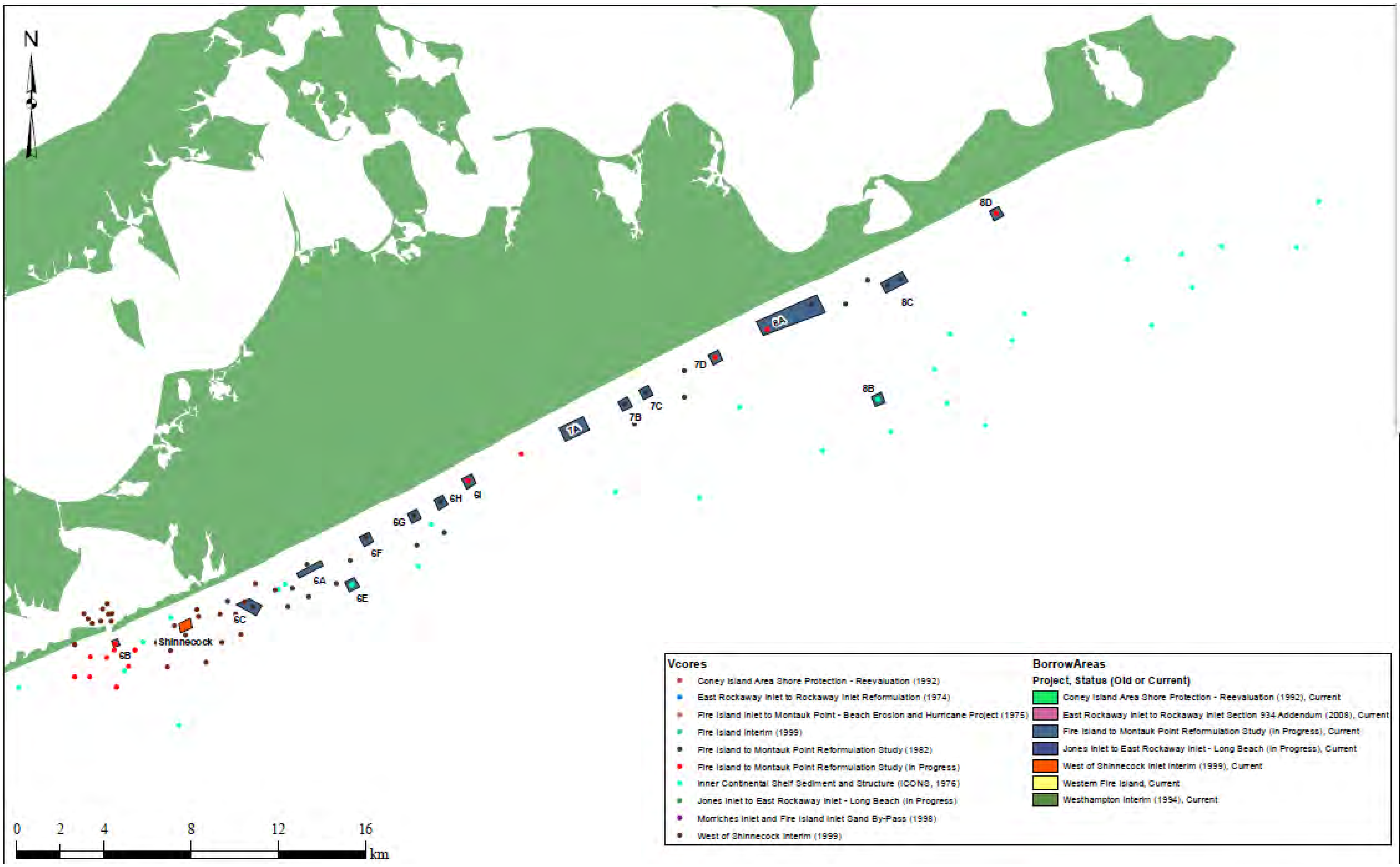

Figure 5. Active borrow sites for Montauk

3.2.1 Long Beach (LB)

Figure 6. Long Beach, New York

The LB project area is located on the south shore of Long Island consisting of approximately nine miles of oceanfront barrier island habitat from Jones Inlet to East Rockaway Inlet. The area is subject to direct wave action and flooding during major storms and hurricanes, causing damage to structures located along the barrier island. A historical low height and narrow width of the beach front has increased the potential for storm damage. Damaging storms have occurred in 1938, 1950, 1953, 1960, 1962, 1984, 1991, 1992, and 2012. In October 2012, Super Storm Sandy was credited with over $250 million dollars of damage. This project will provide coastal storm damage risk reduction to the highly developed communities in this area. The initial dredging has been completed for this project.

Table 2. The volume of renourishment fill at Long Beach, New York

Volume Type	**Volume (CY)**
Renourishment Fill	1,770,000

Timeline

Long Beach is a NYSDEC permitted project that just completed its initial construction and is covered under its previous informal section 7 consultation until this biological opinion goes into effect. The dredging and beach renourishment will continue every four years from 2024 until 2037. Dredging will only be done between the months of October through March. The Aquatic Biological Monitoring trawling at the NYOBA for this project will occur two days a month from April to September during the years 2020-2039 (see section 3.2 for more details).

3.2.2 Fire Island to Moriches Inlet (FIMI)

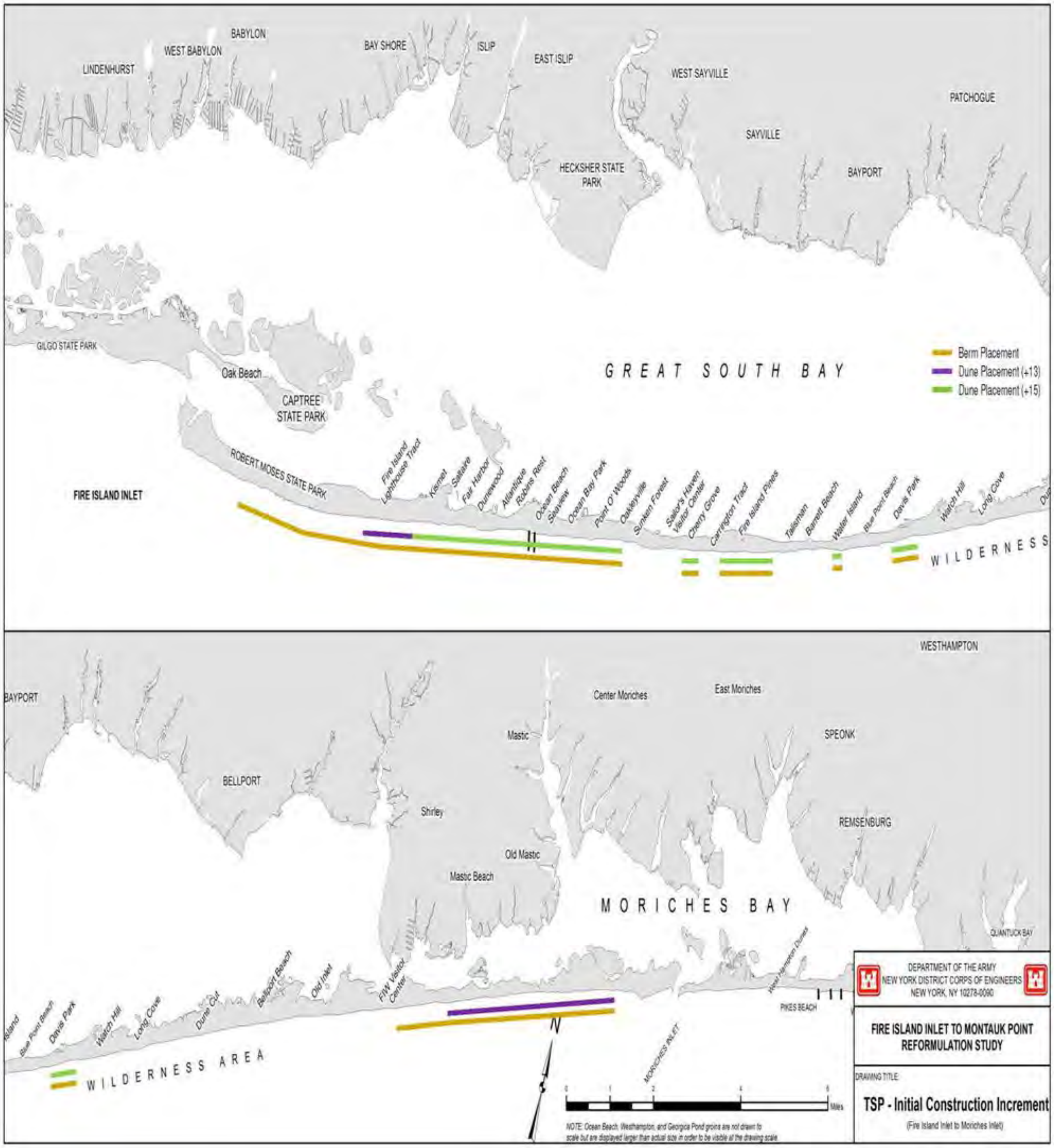

Figure 7. Fire Island to Moriches Inlet (FIMI), New York

The authorized FIMI project provides for hurricane protection and beach erosion control along five reaches of the south shore of Long Island between Fire Island Inlet and Montauk Point, a distance of approximately 83 miles. The initial dredging has been completed for this project. No renourishment cycles are planned for the proposed project, because it was a one-time emergency action and the upcoming Fire Island to Montauk Point (FIMP) project will be located in approximately the same footprint and includes maintenance activities.

Timeline
All dredging for FIMI has been completed. The Aquatic Biological Monitoring trawling (see section 3.2 for more details) at the NYOBA for this project will occur two days a month from April to September during years 2020-2022.

3.2.3 East Rockaway (ER)

Figure 8. East Rockaway, New York

The plan along the Atlantic Ocean Shorefront consists of:

- A composite seawall with a structure crest elevation of +17 feet (NAVD88), the dune elevation is +18 feet (NAVD88), and the design berm width is 60 feet (not in water);
- A beach berm elevation of +8 feet NAVD and a depth of closure of -25 feet NAVD (not in water);
- A total beach fill quantity of 804,000 CY for the initial placement, including tolerance, overfill of nourishment, and advanced nourishment ahead of time with a four year renourishment cycle of 2,300,000 CY, resulting in a minimum berm width of 60 feet (Table 3);
- Extension of five existing groin structures for shoreline stabilization; and
- Construction of 13 new groins.

Table 3. The volume of initial beach fill and renourishment fill at East Rockaway, New York

Volume Type	**Volume (CY)**
Initial Fill	804,000
Renourishment Fill	2,300,000

Stone groins will also be repaired and constructed using land based equipment. The work will occur in-water during any tide cycle. The plan for ER along the Jamaica Bay/Back Bay (JB/BB) component of the project is a combination of High Frequency Flood Risk Reduction Features (HFFRRF) such as bulkheads and floodwalls, and natural and nature-based non-structural features (NNBFs). The bulkheads will be made of steel sheet piles. The method of pile driving is not determined, but would likely be accomplished by either vibration hammering or a low key speed vibratory drilling process. To be conservative, the effects of noise from using an impact hammer, will be analyzed, in case it is used. A turbidity curtain will be used while pile driving to minimize the increase in suspended sediment.

Timeline

The East Rockaway project has a signed Chief's Report as of August 2019. The first contract for the construction of fourteen (14) new stone groin structures and rehabilitation of five (5) existing groins on the Atlantic Ocean side of the Rockaway peninsula was awarded in April 2020. They are expected to be completed in 2023. The initial beach nourishment dredging will occur year-round from October 2023 through September 2024. The dredging for beach renourishment will occur every four years from 2027 to 2037 only during the months of October through March. The Aquatic Biological Monitoring trawling at the NYOBA for this project will occur two days a month from April to September during the years 2022-2039 (see section 3.2 for more details). For the ER, there will be no trawling from April 7 through May 25.

3.2.4 Fire Island to Montauk Point (FIMP)

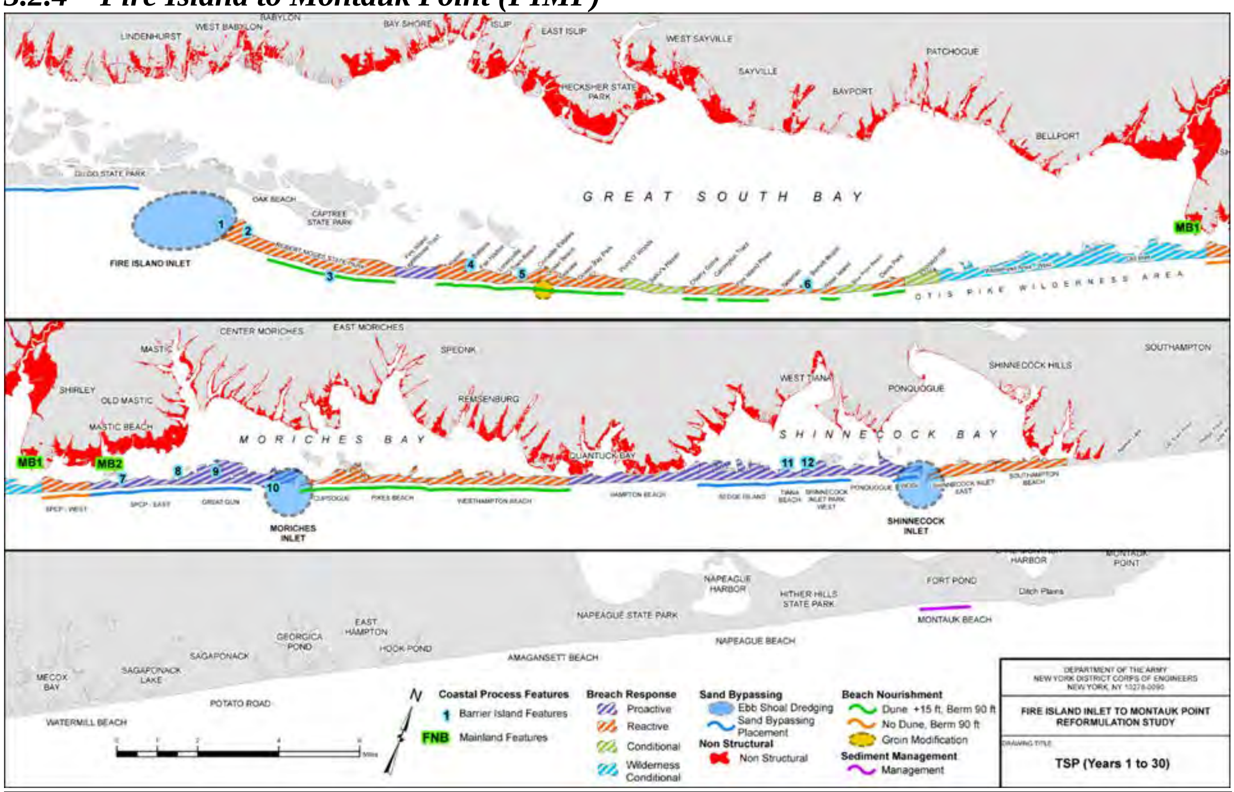

Figure 9. Fire Island to Montauk Point (FIMP), New York – Recommended Plan (Years 1-30)

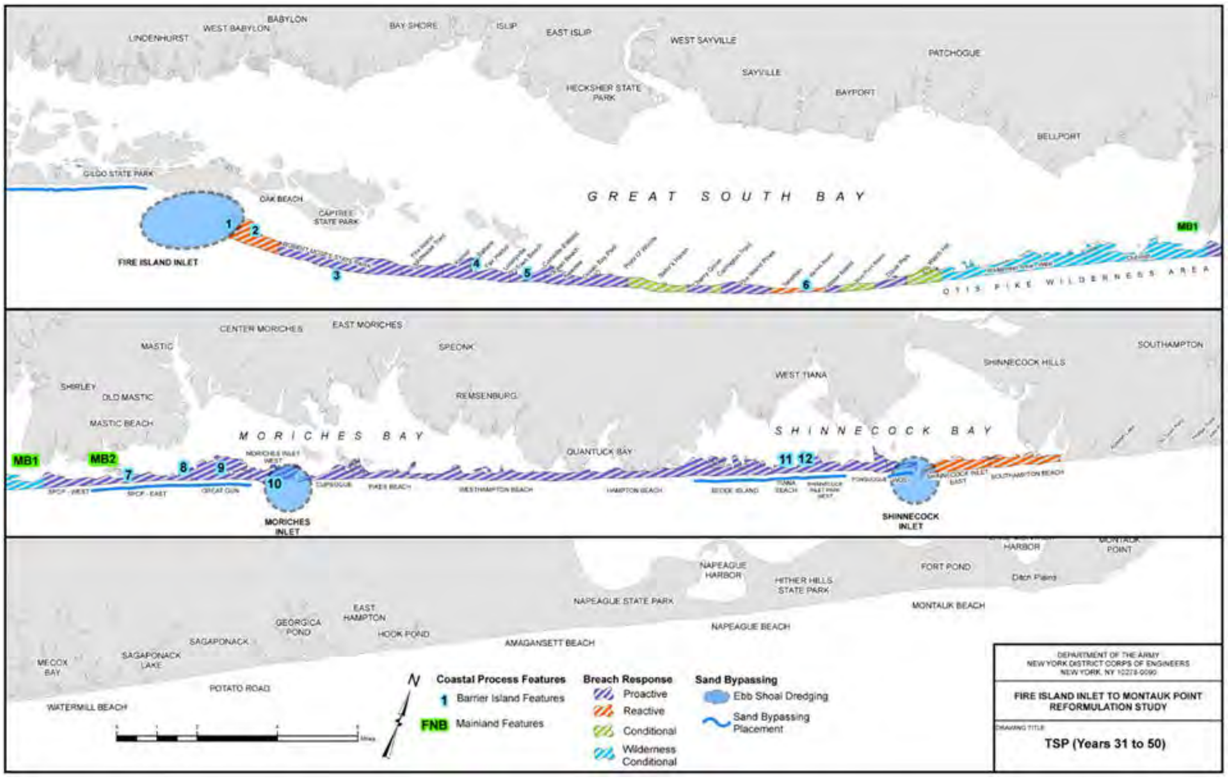

Figure 10. FIMP - Recommended Plan (Years 31 to 50)

The authorized FIMP project provides for hurricane protection and beach erosion control along five reaches of the south shore of Long Island between Fire Island Inlet and Montauk Point, a distance of approximately 83 miles, similar to the FIMI project. This project also authorizes Federal participation in periodic nourishment. The project will involve the following:

Inlet Sand Bypassing

- Sand nourishment that bypasses across Fire Island, Moriches, and Shinnecock Inlets to restore the natural longshore transport of sand along the barrier island for 50 years. Scheduled Operation and Maintenance (O&M) dredging of the authorized navigation channel and deposition basin with sand placement on the barrier island will be supplemented, as needed, by dredging from the adjacent ebb shoals of each inlet to obtain the required volume of sand needed for bypassing.
- The bypassed sand will be placed in a berm template at elevation +9.5 feet National Geodectic Vertical Datume of 1929 (NGVD 29) in identified placement areas (not in water).
- Monitoring is included to facilitate adaptive management changes.

Mainland Nonstructural

- Addresses approximately 4,432 structures within the 10 year floodplain using nonstructural measures, primarily elevating existing structures (e.g., houses raised on stilts) and building retrofits, based upon structure type and condition (no in water work).

- Includes localized acquisition in areas subject to high frequency flooding, and reestablishment of natural floodplain function (no in water work).

Breach Response on Barrier Islands – Provides for the following types of Breach Response

- Proactive Breach Response – is a response plan involving unscheduled beach nourishment which is triggered when the beach and dune are lowered below a 4% level of performance and provides for restoration of a dune at +13 feet. NGVD and a 90 foot. berm.
- Reactive Breach Response – is a response plan which is triggered when a breach has physically occurred (e.g., the condition where there is an exchange of ocean and bay water during normal tidal conditions). It is utilized, as needed, in locations that receive beach and dune placement, and also in locations where there is agreement that a breach should be closed quickly, such as Robert Moses State Park and the Talisman Federal tract.
- Conditional Breach Response – is a response plan that applies to the large, Federally-owned tracts within Fire Island National Seashore where the Breach Closure Team determines whether the breach is closing naturally, and if it's found not to be closed at Day 60, that closure would begin on Day 60. Conditional Breach closure provides for a 90 foot wide berm at elevation +9.5 feet and no dune.
- Wilderness Conditional Breach Response – is a response plan that applies to the Wilderness Federally-owned tracts within Fire Island National Seashore, where the Breach Closure Team determines whether a breach should be closed, based upon whether the breach is closing naturally and whether the breach is likely to cause significant damage.

Beach and Dune Fill on Shorefront

- Construction of a 90 foot wide berm and +15 foot dune along the developed shorefront areas on Fire Island and Westhampton barrier islands (no in water work).
- All dunes will be planted with dune grass (no in water work).
- On Fire Island the post-Sandy optimized alignment is followed and includes overfill in the developed locations to minimize tapers into Federal tracts.
- Renourishment takes place approximately every three years during 2023-2037 after intial dredging completion in 2022, plus three additional events during this time frame.
- Implementation of an adaptive management to ensure the volume and placement configuration accomplishes the design objectives of offsetting long-term erosion.
- Construction of a feeder beach every three years during years 2023-2037 at Montauk Beach.

Groin Modifications

- Removal of the existing Ocean Beach groins via land-based and marine-based construction equipment, as required.

Coastal Process Features (CPFs)

- Provides CPFs for 12 barrier island locations and two mainland locations as coastal process features
- Initial placement of approximately 4.2 M CY of sediment in accordance with the Policy Waiver for a Mutually Acceptable Plan between the Department of the Army and the Department of the Interior. Sediment will be placed along the barrier island bayside shoreline over the period of analysis that reestablishes the coastal processes consistent with the reformulation objective of no net loss of habitat or sediment. The placement of sediment along the bay shoreline will be conducted in conjunction with other nearby beach fill operations undertaken on the barrier island shorefront.
- The CPFs will compensate for reductions in cross-island transport and sediment input to the Bay, offset ESA impacts to protected birds from the placement of sediment along the barrier island shorefront, augment the resiliency and enhance the overall barrier island and natural system coastal processes.

Adaptive Management

- Monitoring and the ability to adjust specific project features to improve effectiveness and achieve project objectives.
- Climate change will be accounted for with the monitoring of climate change parameters, identification of the effect of climate change on the project design and identification of adaptation measures that are necessary to accommodate climate changes as it relates to all the project elements.

Timeline

The FIMP initial dredging is expected to involve dredging 4,200,000 CY of sediment is scheduled to commence anytime during the year from October 2021 through September 2022. Total dredging for renourishment maintenance is expected to involve dredging 3,000,000 CY of sediment, with the dredging only occurring every three years plus three additional events from October through March beginning in 2023 and the final contract concluding in 2037. The Aquatic Biological Monitoring trawling at the NYOBA for this project will occur two days a month from April to September during the years 2020-2039 (see section 3.2 for more details).

3.3 Aquatic Biological Monitoring

The NYSDEC under their CWA jurisdiction requires biological monitoring to document aquatic resources utilizing the borrow areas. To this end, you started the Atlantic Coast of Long Island Aquatic Biological Monitoring (ABM) Program to meet this requirement for the completed FIMI project and the LB project currently under construction. The ER and FIMP projects are not yet in the phase of work to apply for and receive a Water Quality Certification. However, for the purpose of this analysis, we assume that similar biological monitoring will be required and that the ABM program will be expanded to include the two projects (ER and FIMP) that are currently under study.

The ABM program comprises of two elements; benthic grabs and fish trawls. Based on a previous ABM report (Tetra Tech 2019), a $0.1 m^2$ Smith-McIntyre grab is generally used. We do not expect that the benthic grab element to affect listed species under our jurisdiction except for the modification of habitat.

We will consider the intensity of trawling that is expected to occur at ER and FIMP to be the same as is required for LB and FIMI based on the assumption that the biological monitoring trawls will be the same as what is currently required for the borrow areas used for the LB and FIMI projects. The decades-long (since 1980s) and ongoing fish trawl element of the biological monitoring program utilizes a 30 foot otter trawl, with 1 inch mesh and ¾ inch cod end liner. Previous sampling program reports, document an average of 120 trawl tows per sampling season per sampling site (two days per month) between April and September (six months). For the ER, no sampling will occur from April 7 through May 25. Each transect tow encompasses approximately ¼ nautical miles, or the equivalent of 8-10 minute transects, at an average speed of two to three knots. The tow times will be 10 minutes long. Borrow area monitoring operations have been ongoing, periodically, for decades (on an 'as needed' basis and per mandate as included in current construction project's NYSDEC Water Quality Certification (WQC)). These trawls would not occur but for the dredging of the NYOBA. Sampling is usually done every year before and during each dredge event. Sampling is then completed during the two following years after each dredge event.

3.4 Project Vessels and Project Summary

A typical beach nourishment project requires the deployment of one hydraulic dredge, one crew boat, two barges, and two tugs. The Aquatic Biological Monitoring sampling only involves one vessel as summarized below for each project (Table 4). Origination of vessels is unknown at this time, but, typically, dredge contractors utilize berth and dry-dock facilities close to the project location to offset costs. Dredges, tugs and scows or barges travel at or below 10 knots/hour, while the crew boat may exceed 10 knots/hour, but, will limit speed to less than 20 knots/hour due to fuels costs and safety constraints.

Table 4. Project schedule and the typical number of vessels and trips for the four beach nourishment projects (LB, FIMI, ER, and FIMP) during dredging, beach placement, construction, and Aquatic Biological Monitoring sampling.

Project	**Vessels**	**Schedule**	**Estimated Amount Left to Be Dredged**	**# Trips/day**	**Borrow area sampling**
LB	6 (one dredge)	Renourishment dredge events: October-March every four years (2024-2037)	Renourishment: 1,770,000 CY	Barges/tugs: ~7/project Dredge: ~8/day	April-September 2020-2039 One vessel Two days a month

Project	Vessels	Schedule	Estimated Amount Left to Be Dredged	# Trips/day	Borrow area sampling
FIMI	6 (one dredge)	All dredging is completed.	0 CY	Barges/tugs: ~7/project Dredge: ~8/day	April-September 2020-2022 One vessel Two days a month
ER	6 (one dredge)	Initial construction / dredging: October-September (2023-2024) Renourishment dredge events: October-March every four years (2027-2037)	Initial: 804,000 CY Renourishment: 2,300,000 CY	Barges/tugs: ~7/project Dredge: ~8/day	April-September 2022-2039 One vessel Two days a month*
FIMP	6 (one dredge)	Initial construction / dredging: October-September (2021-2022) Renourishment dredge events: October-March every three years (2023-2037) plus three additional events during this time frame	Initial: 4,200,000 CY Renourishment: 3,000,000 CY	Barges/tugs: ~7/project Dredge: ~8/day	April-September 2020-2039 One vessel Two days a month

*For the ER there will be no sampling from April 7 through May 25

3.5 Project Timing

A summary of the proposed annual schedules for construction (sand removal) and the coverage of the biological trawling program, and their interface with protected species possibly seasonally utilizing the area is summarized in Table 5.

Table 5. Summary of protected species presence - Federal action work window interface at the NYOBA. Note: the initial dredge event for each site could occur during any time of year from October to September, but the subsequent renourishment cycles will only occur between October and March.

Species/Volume Processed/Trawl Coverage	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atl. Sturgeon	Juv												
	SubAd												
	Adult												
Loggerhead	Adult												
Kemps Ridley	Adult												
Green	Adult												
Leatherback	Adult												
NA Right Whale	Adult												
Finback	Adult												

ndicates that species/life stage and the time of year that they may be present in the action area (Note: Juvenile Atlantic sturgeon are not expected to be present in the action area, but are included in the table to show the entire work window).

indicates in-water work period for dredging, bulkhead construction, groin contruction/removal, and beach nourishment during the renourishment cycles. Note: the initial dredge event for each site could happen during any time of year, but the subsequent renourishment cycles will only occur from October to March and there will be a ‘no dredge’ seasonal restrictions from Apr 1- 30 Sept).

indicates annual in-water work period for biological monitoring trawling (April-September) at NYOBA (between 20’ to 70’ contour, from ER inlet to Montauk Pt). For the ER, there will be no sampling from April 7 through May 25.

3.6 Project Monitoring

All sturgeon caught will be identified to species, measured for fork length (FL) and total length (TL) to the nearest millimeter, and weighed to the nearest gram. An approximately 1 cm^2 piece of pelvic fin will be clipped and retained in ethanol for genetic analysis.

3.7 Best Management Practices

3.7.1 Hopper Dredging

- Speed of the hopper dredge while dredging at the borrow area will be 2.6 knots.
- All dredges will be equipped with turtle/sturgeon deflectors that have been properly installed in front of the draghead and will be used at all times.
- Starting immediately upon project commencement, all project vessels will have an on deck NMFS-approved protected species observer to monitor for Atlantic sturgeon, sea turtles, and whales. Monitoring requirements include checking for turtles or sturgeon (whole or parts) impinged on the draghead, in the hopper, and swimming/present at or near the surface. If the protected species observer on board observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds will be limited to 10 knots. If a right whale is observed, the vessel will maintain a 500 yard buffer from the whale. For all other whale species, a 100 yard buffer will be maintained.
- The draghead will remain on the bottom at all times during a pumping action except when: the dredge is not in pumping operation, or, the pumps are completely shut off; the dredge is being re-oriented to the next dredge line during dredging activities; or the vessel's safety is at risk.
- Upon completion of the dredge track line, the drag tender will throttle back on the RPMs of the suction pump engine to idle speed prior to raising the draghead off the bottom so that no

flow of material is coming through the pipe into the hopper. Prior to raising the draghead, no suction will remain in the draghead or the dragarm in order to prevent impingement during the dragarm lifting phase. Prior to actual lifting of the dragarm from the bottom, the draghead will be held firmly on the bottom for 10 to 15 seconds (with no suction) then lifted rapidly to midwater to further reduce the potential for an interaction with an ESA-listed species. The dredge will then be re-oriented quickly to the next dredge line and the draghead will be firmly repositioned on the bottom before bringing the suction pump up to pumping speed.

3.7.2 Bulkhead Construction

- A turbidity curtain will be used while pile driving to minimize the increase in suspended sediment.

3.8 Action area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR§402.02). For this project, the action area includes the offshore borrow area (NYOBA), all routes traveled by the project and biological monitoring vessels (between the homeports (currently unknown), the borrow area and the beaches to be renourished), the area of the pipeline from the dredge to the beach nourishment sites, the areas where construction will occur, and the underwater areas where the consequences of dredging, construction, beach nourishment (*i.e.*, increases in suspended sediment from dredging and sand placement; noise, etc.), and the biological monitoring program consequences could be experienced.

Based on this information, the action area consists of the project footprint of the NYOBA areas that will be dredged, up to a 731 meter radius around the dredge sites, the area of where the pipelines will be, the area within 500 meters down-current from discharge pipe where sediments will be deposited, the area within the turbidity curtain while pile driving, and a 90 meter radius at the pile driving site to account for the maximum extent of the acoustic behavioral threshold for protected species, and all routes traveled by the project and biological monitoring vessels. All work that is occurring out-of-water or in the dry will not be discussed further.

3.8.1 Habitat in the Action Area

The sediments in the areas to be dredged consist of mostly sand and gravel (90% sand). Benthic resources at the borrow area are limited, but do include a diversity of species including those types considered primary prey species for sturgeon and sea turtles (crustaceans and mollusks). The borrow areas range approximately from 23 to 78 feet in depth (Tetra Tech 2019). There are no sea grasses and no Submerged Aquatic Vegetation (SAV) at the borrow areas.

4 STATUS OF LISTED SPECIES IN THE ACTION AREA

We have determined that the action being considered in this biological opinion may affect the following endangered or threatened species under our jurisdiction (Table 6):

Table 6. ESA-listed species in the action area

ESA-Listed Species	**Latin Name**	**Distinct Population Segment (DPS)**	**Federal Register (FR) Citation**	**Recovery Plan**
Loggerhead Turtle	*Caretta caretta*	Northwest Atlantic	76 FR 58868	(NMFS and USFWS 2008)
Leatherback Turtle	*Dermochelys coriacea*	Range-wide	35 FR 8491	(NMFS and USFWS 1992)
Green Turtle	*Chelonia mydas*	North Atlantic	81 FR 20057	(NMFS and USFWS 1991)
Kemp's Ridley Turtle	*Lepidochelys kempii*	Range-wide	35 FR 18319	(NMFS (National Marine Fisheries Service) *et al.* 2011)
North Atlantic Right Whale	*Eubalaena glacialis*	Range-wide	73 FR 12024	(NMFS 2005)
Fin Whale	*Balaenoptera physalus*	Range-wide	35 FR 18319	(NMFS 2010)
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Gulf of Maine; New York Bight; Chesapeake Bay; Carolina; South Atlantic	77 FR 5880 and 77 FR 5914	N/A

There is no designated critical habitat present in the action area for any of these species.

This section will focus on the status of the various species within the action area, summarizing information necessary to establish the environmental baseline and to assess the consequences of the proposed action.

4.1 Species Not Likely to be Adversely Affected by the Proposed Action

4.1.1 Whales

Federally endangered North Atlantic right whales and fin whales are expected to occur in

New York nearshore and coastal waters of the action area,. Fin and right whales use the nearshore coastal waters of the Atlantic Ocean as they migrate to and from calving and foraging grounds.

Right whales in the New York Bight are primarily transiting the area on their way to northern feeding and aggregation areas. During late winter and early spring, they begin moving north along the coast past Cape Hatteras and near the Long Island coast. Individuals have been sighted along the south shore of Long Island, Block Island Sound, Gardiners Bay and south shore inlets and bays. They could be present in the action area year-round.

Finback whales occupy both deep and shallow waters and are likely the most abundant large cetacean in New York waters. They are most abundant in spring, summer, and fall, but do have some presence during the winter months. Therefore, fin whales could be present in the action area year-round.

4.1.1.1 Consequences of the Proposed Action on Whales

ESA listed species of whales will not occur in the shallow areas where pile driving and beach nourishment will occur and, thus, will not be exposed to any effects of pile driving and fill/beach placement activities. ESA listed species of whales may be present within the NYOBA where dredging and aquatic biological monitoring will occur. Because whales forage upon pelagic prey items (e.g., krill, copepods), dredging and its impacts on the benthic environment will not have any direct effects on whale prey/foraging items. As dredging occurs at speeds at or less than 2.6 knots in the open waters of the Atlantic ocean with ample space for whales to move around the dredge, migratory behaviors of ESA listed whales will also not be affected, nor will whales be exposed to any direct effects of interactions with dredge heads as the dredge head will be placed on the ocean floor during operations. As such, this section will only address the effects of vessel traffic, water quality, and aquatic biological monitoring to whales at the NYOBA, while transiting back and forth from NYOBA and the coastline.

Vessel Traffic

Impacts to listed species of whales during sand mining are unlikely because hopper dredges move very slowly at < 2.6 knots, a speed at which whales can avoid interaction with the dredge. On the other hand, collisions with a transiting hopper dredge between NYOBA and the project areas could occur on the Atlantic side of the project areas. An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death of a whale increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at 10 knots or less, the probability is further reduced to approximately 30%. The speed of the dredge in the proposed projects is not expected to exceed 2.6 knots while dredging, and 10 knots while transiting to/from the NYOBA and shoreline, thereby reducing the likelihood of vessel collision impacts.

Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Ship strike injuries to whales occur in two ways: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist *et al.* 2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist *et al.* (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003, Laist *et al.* 2001).

Collisions with a slowly transiting hopper could occur, but the speed (10 knots) during transit lessens the probability of a ship strike resulting in lethal or serious injuries. Onboard lookouts also may further reduce the risk of vessel-whale collisions. Having an onboard lookout is standard protocol and you have agreed to adhere to this. If the lookout on board the hopper dredge observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds would be limited to 10 knots. If a right whale is observed, the vessel would maintain a 500 yard buffer from the whale. For all other whale species, a 100 yard buffer would be maintained.

The potential for adding a minimal number of project vessels to the existing baseline increases vessel strike risk to whales, but it is to such a small extent that the increase in risk of a potential strike cannot be meaningfully measured or detected. The increase or change in traffic associated with this proposed project is small. Dredging operations typically add approximately six vessels to the action area. Dredging operations, similarly, exclude other vessels unrelated to the project from the action area while dredging is underway in the action area. While it is your conclusion that there is a net gain of zero vessels added to the action area, due to the dredging operations established exclusionary zones implementation as well as the mandatory reduced speed of those vessels (as opposed to non-project-related vessels), to be conservative, we will assume an addition of six vessels to the action area resulting from the Federal action. The addition of these project-related vessels will be intermittent (October through September for the initial dredging; October through March of any year for the renourishment dredging), temporary (seven to eight trips per day during planned nourishment cycles, until 2039), and restricted to a small portion of the overall action area on any day dredging occurs. Once dredging is completed, the pre-project status quo of likely vessel numbers and vessel traffic patterns will remain, and, thus, permanent increases in the risk of vessel strikes will not occur. Given that the action area is in a coastal ocean environment where listed species are able to disperse widely, and due to the temporary and localized operation of the vessels associated with the Federal action, the risk of vessel strike is extremely unlikely. As a result, the effect of the action on the risk of a vessel strike in the action area is discountable.

Sedimentation and Turbidity

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column further from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Hopper dredges re-suspend sediment when the suction draghead(s) make contact with the substrate and during release of overflow waters, which generally occurs through the bottom of the vessel's hull. Hopper dredges have a large range in capacities and different draghead configurations. Plumes generated during hopper dredging of sandy entrance channels will have very different spatial and temporal characteristics than those created in silt-laden harbors. Near-bottom plumes caused by hopper dredges may extend approximately 2,300 to 2,400 feet (701-731 meters) down-current from the dredge (USACE 1983). According to Wilber and Clarke (2001), suspended sediment plumes can extend 3,937 feet (1,200 m). Total Suspended Sediment (TSS) concentrations may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead. In a literature review conducted by Anchor Environmental (2003), near-field concentrations ranged from 80.0-475.0 mg/L. TSS and turbidity levels in the near-surface plume usually decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations and turbidities. In almost all cases, the majority of re-suspended sediments resettle close to the dredge within one hour, although very fine particles may settle during slack tides only to be re-suspended by ensuing peak ebb or flood currents (Anchor Environmental 2003). If those re-suspended sediments do resuspend in the ebb/flood tides, it just becomes part of the normal tidal cycle and represents "ambient" conditions.

Cutterhead dredges use suction to entrain sediment for pumping through a pipeline to a designated discharge site. Production rates vary greatly based on pump capacities and the type (size and rotational speed) of cutter used, as well as distance between the cutterhead and the substrate. Sediments are re-suspended during lateral swinging of the cutterhead as the dredge progresses forward. Modeling results of cutterhead dredging indicated that TSS concentrations above background levels would be present throughout the bottom six feet (1.8 meters) of the water column for a distance of approximately 1,000 feet (305 meters) (USACE 1983). Elevated suspended sediment levels are expected to be present only within a 91-152 foot (300-500 meters) radius of the cutterhead dredge (USACE Hayes *et al.* 2000, LaSalle 1990, 1983, Wilber and Clarke 2001). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad 2001, USACE 2015).

TSS is most likely to affect whales if a plume causes a barrier to normal behaviors or if elevated levels of suspended sediment affects prey. Whales may be exposed to effects of TSS or other water quality factors through the uptake of water when they feed. Even if whales ingested the transient plumes, it would be brief and low in frequency. As whales breathe air and are highly mobile, they are likely to be able to avoid any sediment plume and any effect on their movements is likely to be insignificant. While the increase in suspended sediments may cause whales to alter their normal movements, any change in behavior is not able to be measured or detected, as it will only involve minor movements that alter their course out of the way of the sediment plume, which will not disrupt any essential life behaviors. The TSS levels expected for dredging (up to 550.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L)(Burton 1993, Wilber and Clarke 2001). The whales that may be present in the action area feed on krill and small schooling fish. No impacts to these forage fish are likely to result from exposure to increased suspended sediment from these dredges during dredging operations. Based on this information, we believe the effects of suspended sediment on whales resulting from increased turbidity from dredging are too small to be meaningfully measured or detected and are insignificant.

<u>Aquatic Biological Monitoring Program</u>
Due to their size, right and fin whales are extremely unlikely to be captured in otter trawl gear. There have been no documented interactions between right and fin whales and the North Atlantic bottom trawl fishery. Their great size and mobility presumably allows them to avoid interactions with the relatively slow moving trawl gear.

Right and fin whales are not expected to be affected by the use of bottom otter trawl gear for this action given that these large cetaceans have the speed and maneuverability to get out of the way of oncoming mobile gear, including trawl gear. Given this information, it is reasonable to anticipate that no interactions of large whales with otter trawl gear will occur in the future and any consequences from the Aquatic Biological Monitoring Program would be limited to slight alterations of a whale's movements to avoid an interactions and are extremely unlikely to occur.

4.2 Species Likely to be Adversely Affected by the Action

4.2.1 Sea Turtles
With the exception of loggerheads and greens, sea turtles are listed under the ESA at the species level rather than as subspecies or DPSs. Therefore, information on the range-wide status of Kemp's ridley and leatherback sea turtles is included to provide the status of each species overall. Information on the status of loggerhead and green sea turtles will only be presented for the DPS affected by this action. Additional background information on the range-wide status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (Conant *et al.* 2009, Hirth 1997, NMFS and USFWS 1995, NMFS and USFWS 2007, NMFS and USFWS 2013, 2007, 2015, Seminoff *et al.* 2015, TEWG 1998, 2000, TEWG 2007, TEWG 2009), and recovery plans for the loggerhead sea turtle (NMFS and USFWS 2008), Kemp's ridley sea turtle (NMFS *et al.* 2011), green sea turtle (NMFS and USFWS 1991), and leatherback sea turtle (NMFS and USFWS 1992, 1998a).

2010 BP Deepwater Horizon Oil Spill
The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. This extensive oiling event contaminated important sea turtle foraging, migratory, and breeding habitats at the surface, in the water column, on the ocean bottom, and on beaches throughout the northern Gulf of Mexico in areas used by different life stages. Sea turtles were

exposed to oil when in contaminated water or habitats; breathing oil droplets, oil vapors, and smoke; ingesting oil-contaminated water and prey; and potentially by maternal transfer of oil compounds to embryos (DWH NRDA Trustees 2016). Response activities and shoreline oiling also directly injured sea turtles and disrupted or deterred sea turtle nesting in the Gulf.

During direct at-sea capture events, more than 900 turtles were sighted, 574 of which were captured and examined for oiling (Stacy 2012). Of the turtles captured during these operations, greater than 80% were visibly oiled (DWH NRDA Trustees 2016). Most of the rescued turtles were taken to rehabilitation facilities; more than 90% of the turtles admitted to rehabilitation centers eventually recovered and were released (Stacy 2012, Stacy and Innis 2012). Recovery efforts also included relocating nearly 300 sea turtle nests from the northern Gulf to the east coast of Florida in 2010, with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, 95% of which were loggerheads (http://www.nmfs.noaa.gov/pr/health/oilspill/gulf2010.htm).

Direct observations of the effects of oil on turtles obtained by at-sea captures, sightings, and strandings only represent a fraction of the scope of the injury. As such, the DWH NRDA Trustees used expert opinion, surface oiling maps, and statistical approaches to apply the directly observed adverse effects of oil exposure to turtles in areas and at times that could not be surveyed. The Trustees estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill (DWH NRDA Trustees 2016). Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities. Despite uncertainties and some unquantified injuries to sea turtles (*e.g.*, injury to leatherbacks, unrealized reproduction), the Trustees conclude that this assessment adequately quantifies the nature and magnitude of injuries to sea turtles caused by the DWH oil spill and related activities.

Based on this quantification of sea turtle injuries caused by the DWH oil spill, sea turtles from all life stages and all geographic areas were lost from the northern Gulf of Mexico ecosystem. The DWH NRDA Trustees (2016) conclude that the recovery of sea turtles in the northern Gulf of Mexico from injuries caused by the DWH oil spill will require decades of sustained efforts to reduce the most critical threats and enhance survival of turtles at multiple life stages. The ultimate population level effects of the spill and impacts of the associated response activities are likely to remain unknown for some period into the future.

4.2.1.1 Status of Loggerhead Sea Turtles – Northwest Atlantic DPS

Species Description

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans. Northwest Atlantic Ocean DPS loggerheads are found along eastern North America, Central America, and northern South America (Figure 11).

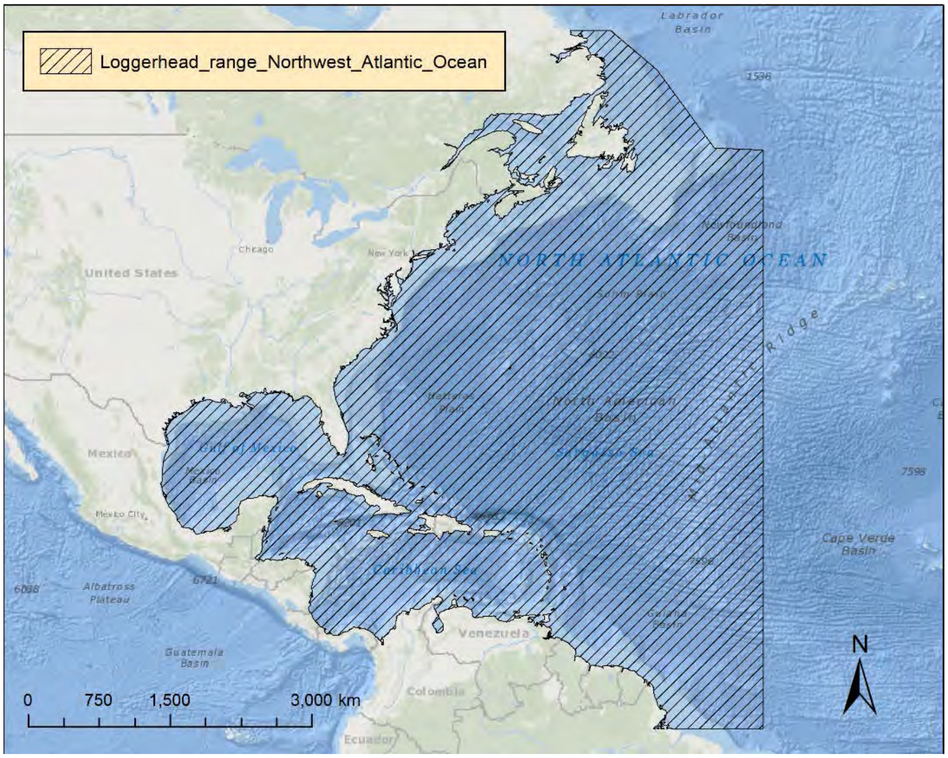

Figure 11. Map identifying the range of the Northwest Atlantic Ocean DPS of loggerhead sea turtles.

The loggerhead sea turtle is distinguished from other turtles by its reddish-brown carapace, large head and powerful jaws (Figure 12). The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800). On September 22, 2011, the NMFS designated nine distinct population segments of loggerhead sea turtles, with the Northwest Atlantic Ocean DPS listed as threatened (75 FR 12598) (Table 7).

Figure 12. Loggerhead turtle. Photo: NOAA.

Table 7. Northwest Atlantic Ocean DPS loggerhead sea turtle information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Caretta caretta	Loggerhead sea turtle	Northwest Atlantic	Threatened	2009	76 FR 58868	2008	79 FR 39855

We used information available in the 2009 Status Review (Conant *et al.* 2009), the final listing rule (76 FR 58868), and recent nesting data from the Florida Fish and Wildlife Research Institute (FWRI) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Mean age at first reproduction for female loggerhead sea turtles is thirty years. Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (*i.e.*, coastal waters). Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Northwest Atlantic Ocean DPS loggerhead sea turtle.

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size. Adult nesting females often account for less than 1% of total population numbers (Bjorndal *et al.* 2005).

Using a stage/age demographic model, the adult female population size of the DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS SEFSC 2009). Based on genetic analysis of nesting subpopulations, the Northwest Atlantic Ocean DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant *et al.* 2009). A more recent analysis using expanded mitochondrial DNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct, and that rookeries from Mexico's Caribbean coast express high haplotype diversity (Shamblin *et al.* 2014). Furthermore, the results suggest that the Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin *et al.* 2012).

Nesting trends for each of the five current recovery units are variable; however, recent data from Florida index nesting beaches, which comprise over 80% of the nesting in the DPS, indicate a 19% increase in nesting from 1989 to 2018 (https://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/; Figure 13).

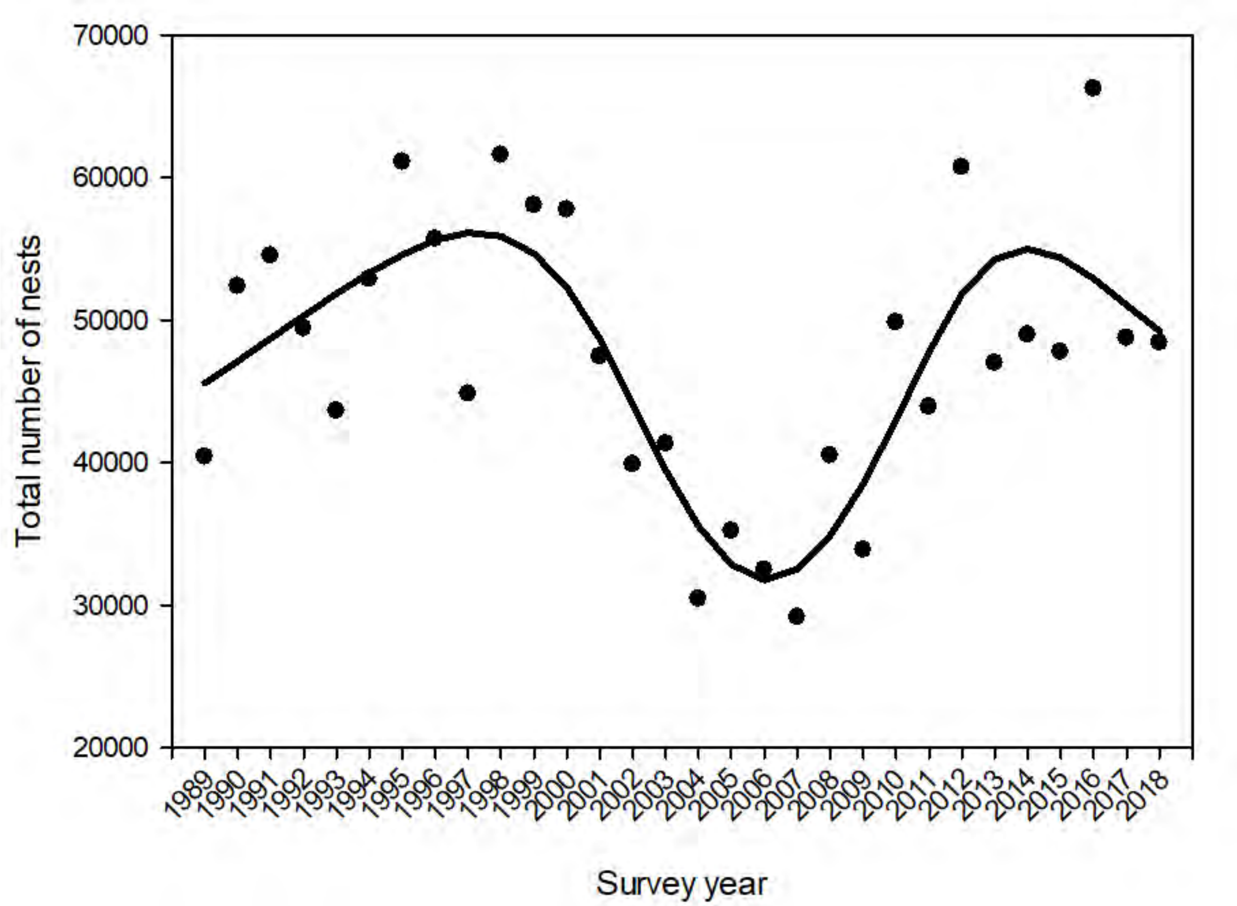

Figure 13. Annual total nest counts for loggerhead sea turtles on Florida index beaches, 1989-2018. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/.

The Peninsular Florida Recovery Unit, which is the second largest loggerhead nesting population in the world, hosts more than 10,000 females nesting annually and 53,000-98,000 nests per year (Ehrhart *et al.* 2003). Nest counts taken at index beaches in Peninsular Florida showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington *et al.* 2009). Florida index beach nesting totaled a minimum of 28,876 nests in 2007, yet a maximum of 65,807 nests in 2016 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

The Northern Recovery Unit, from North Carolina to northeastern Florida, and is the second largest nesting aggregation in the DPS, with an average of 5,215 nests from 1989-2008, and approximately 1,272 nesting females (NMFS and USFWS 2008). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and USFWS 2007).

The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. The only available data for the nesting subpopulation on Key West comes from a census conducted from 1995 to 2004 (excluding 2002), which provided a mean of 246 nests per year, or about sixty nesting females (NMFS and USFWS 2007).

The Northern Gulf of Mexico Recovery Unit has between 100 and 999 nesting females annually. Annual nest totals for this recovery unit averaged 906 nests from 1995-2007 (Conant *et al.* 2009). Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult because of changed and expanded beach coverage. However, there are now over 20 years of Florida index nesting beach survey data for the Northern Gulf of Mexico Recovery Unit. The nesting subpopulation in the Florida Panhandle exhibited a significant declining trend from 1995 to 2005 (Conant *et al.* 2009, NMFS and USFWS 2007), but has experienced an upward trend since 2010 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita *et al.* 2003). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart *et al.* 2003), and over one hundred nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008).

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71%-88%) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madeira, Canary Islands and Andalusia, Gulf of Mexico, and Brazil (Masuda 2010).

Status

Due to past declines in nest counts at index beaches in the U.S. and Mexico, and continued mortality of juveniles and adults from fishery bycatch, the Northwest Atlantic Ocean DPS is at risk and likely to decline in the foreseeable future (Conant et al. 2009).

Recovery Goals

See the 2009 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads for complete down listing/delisting criteria for each of the following recovery objectives.

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.

8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, Federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

4.2.1.2 Status of Kemp's Ridley Sea Turtles

Species Description

The Kemp's ridley turtle is considered to be the most endangered sea turtle, internationally (Groombridge 1982, Zwinenberg 1977). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas (Figure 14).

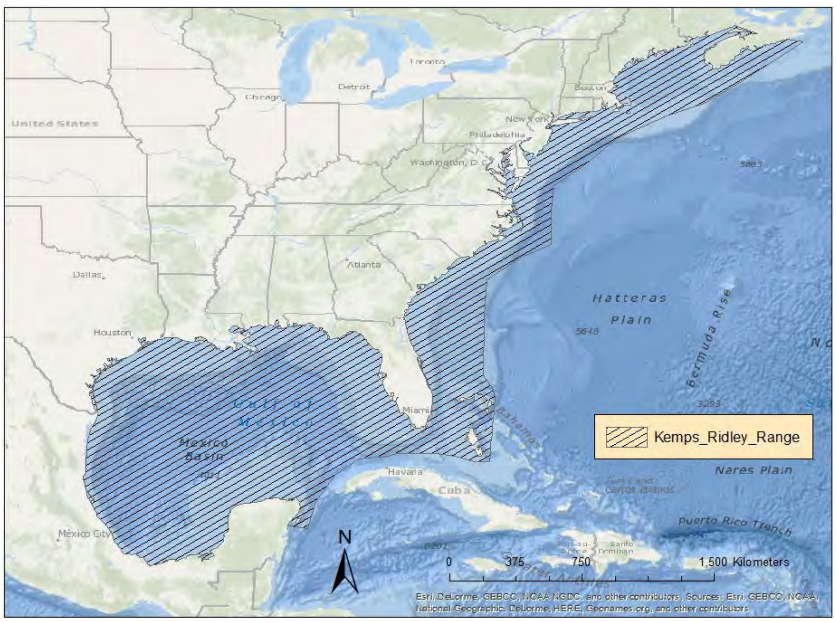

Figure 14. Map identifying the range of the endangered Kemp's ridley sea turtle.

Kemp's ridley sea turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell (Figure 15). The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (Table 8).

We used information available in the revised recovery plan (NMFS *et al.* 2011) and the Five-Year Review (NMFS and USFWS 2015) to summarize the life history, population dynamics and status of the species, as follows.

Table 8. Kemp's ridley turtle information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Lepidochelys kempii	Kemp's ridley sea turtle	None Designated	Endangered range wide	2015	35 FR 18319	2011	None Designated

Life History
Females mature at 12 years of age. The average remigration is two years. Nesting occurs from April to July in large arribadas, primarily at Rancho Nuevo, Mexico. Females lay an average of 2.5 clutches per season. The annual average clutch size is ninety-seven to one hundred eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats. Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep, although they can also be found in deeper offshore waters. As adults, Kemp's ridleys forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS *et al.* 2011).

Population Dynamics
The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Kemp's ridley sea turtle.

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS and USFWS 2015). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, fifty in 2005, 197 in 2009, and 119 in 2014 (NMFS and USFWS 2015).

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell *et al.* 2005); however, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue and the overall trend is unclear (NMFS and USFWS Caillouet *et al.* 2018, 2015).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS *et al.* 2011). Additional analysis of the mitochondrial DNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton *et al.* 2006).

The Kemp's ridley occurs from the Gulf of Mexico and along the Atlantic coast of the U.S. (TEWG 2000). Kemp's ridley sea turtles have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomás and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS *et al.* 2011).

Status

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. A successful head-start program has resulted in the re-establishment of nesting at Texan beaches. While fisheries bycatch remains a threat, the use of turtle excluder devices (TEDs) mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. It is clear that the species is steadily increasing; however, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

Recovery Goals

See the 2011 Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were identified as priorities to recover Kemp's ridley sea turtles:

1. Protect and manage nesting and marine habitats.
2. Protect and manage populations on the nesting beaches and in the marine environment.
3. Maintain a stranding network.
4. Manage captive stocks.
5. Sustain education and partnership programs.
6. Maintain, promote awareness of and expand U.S. and Mexican laws.
7. Implement international agreements.
8. Enforce laws.

4.2.1.3 Status of Green Sea Turtles – North Atlantic DPS

Species description

The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The North Atlantic DPS green turtle is found in the North Atlantic Ocean and Gulf of Mexico (Figure 16).

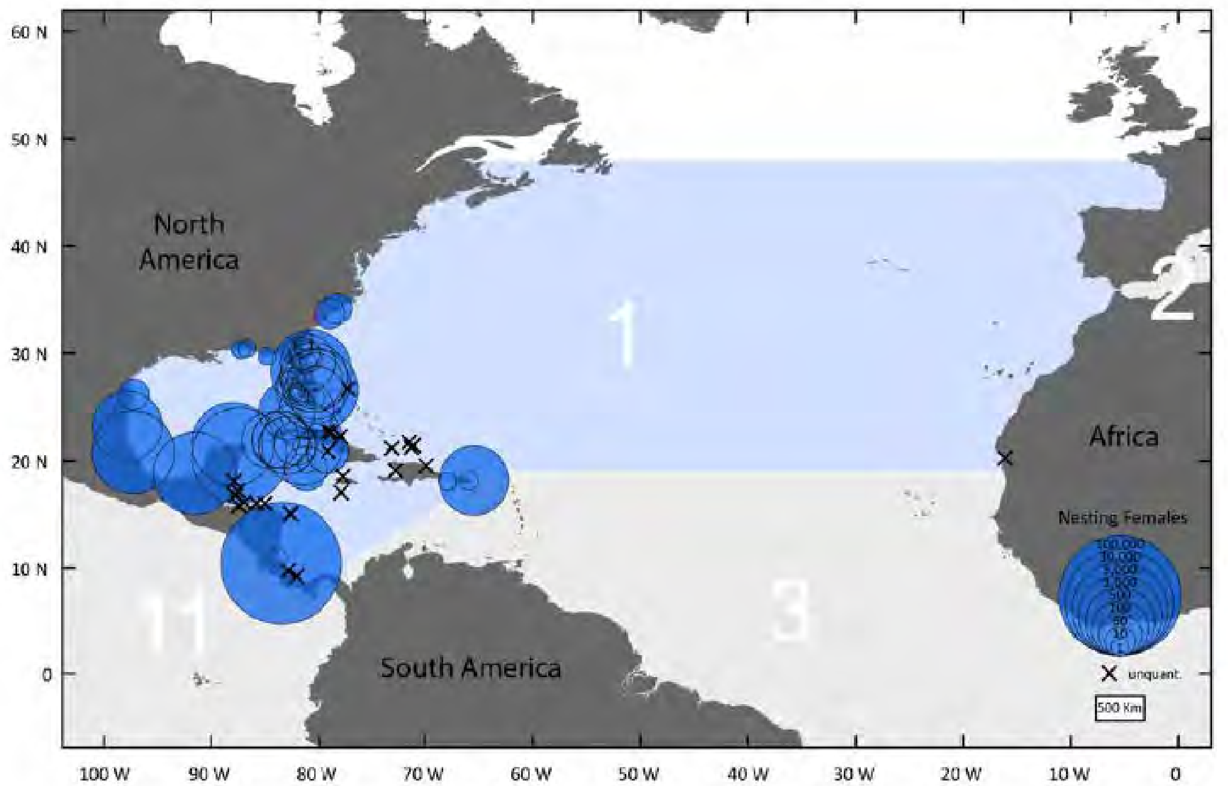

Figure 16. Geographic range of the North Atlantic distinct population segment green turtle, with location and abundance of nesting females. From Seminoff et al. (2015).

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (one meter) (Figure 17). The species was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057) (Table 9). The North Atlantic DPS is listed as threatened.

Table 9. North Atlantic DPS green sea turtle information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Chelonia mydas	Green sea turtle	North Atlantic (4 sub-populations)	Threatened	2015	81 FR 20057	1991	63 FR 46693

We used information available in the 2007 Five Year Review (NMFS and USFWS 2007), 2015 Status Review (Seminoff *et al.* 2015), and recent nesting data from the Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

Life history

Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (*i.e.*, return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey.

Figure 17. Green turtle. Photo: Mark Sullivan, NOAA.

Population dynamics

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the North Atlantic DPS green sea turtle.

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff *et al.* 2015). Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at seventy-three nesting sites, and available data indicate an increasing trend in nesting. The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff *et al.* 2015).

The North Atlantic DPS is showing a positive trend in nesting (Seminoff *et al.* 2015). There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka *et al.* (2008) using data sets of 25 years or more show the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%, and the Tortuguero, Costa Rica, population growing at 4.9%. Since 1989, nest counts at Florida's core index beaches have ranged from less than 300 to almost 39,000 in 2017. Numbers show a mostly biennial pattern of fluctuation, with records set in 2011, 2013, 2015 and 2017 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/; Figure 18).

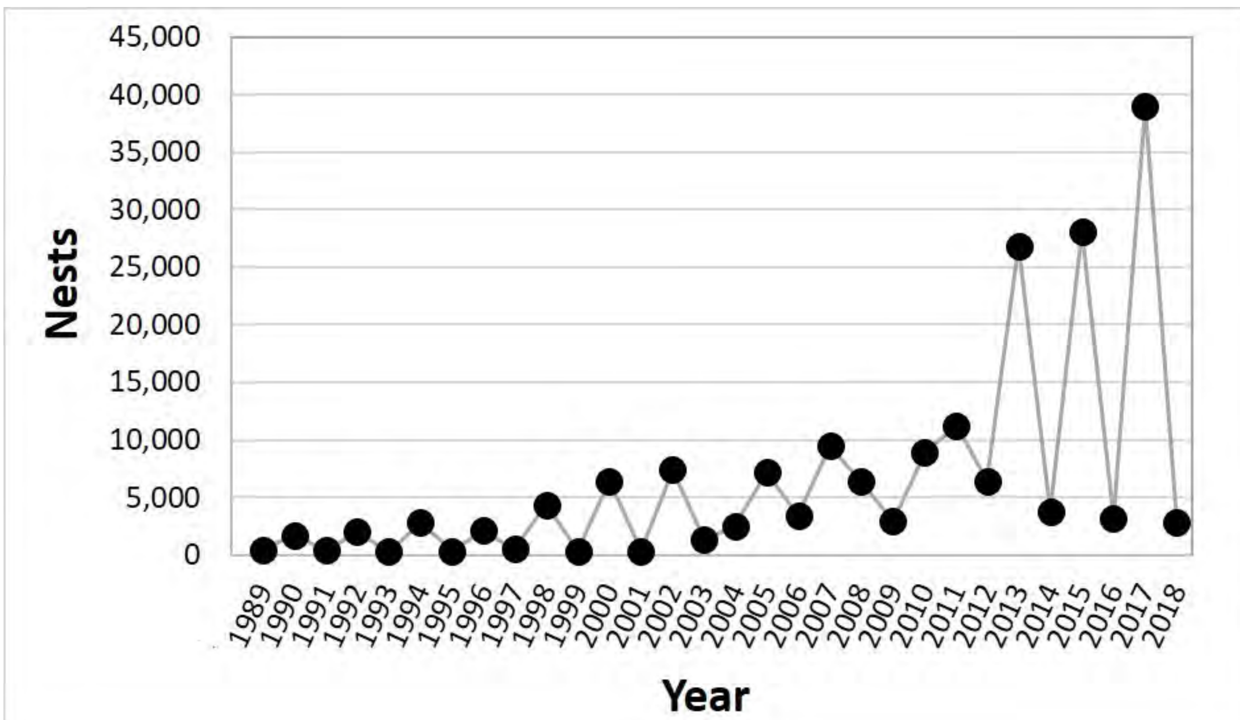

Figure 18. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2018. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the population for the DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico and Costa Rica (Seminoff *et al.* 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin *et al.* 2016).

The green sea turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and 19°N to the western coasts of Europe and Africa (Figure 16). Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba.

Status

Historically, green sea turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to fifty years. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

Recovery Goals

See the 1998 and 1991 recovery plans for the Pacific, East Pacific and Atlantic populations of green turtles for complete down-listing/delisting criteria for recovery goals for the species. Broadly, recovery plan goals emphasize the need to protect and manage nesting and marine habitat, protect and manage populations on nesting beaches and in the marine environment, increase public education, and promote international cooperation on sea turtle conservation topics.

4.2.1.4 Status of Leatherback Sea Turtles

Species Description

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 19).

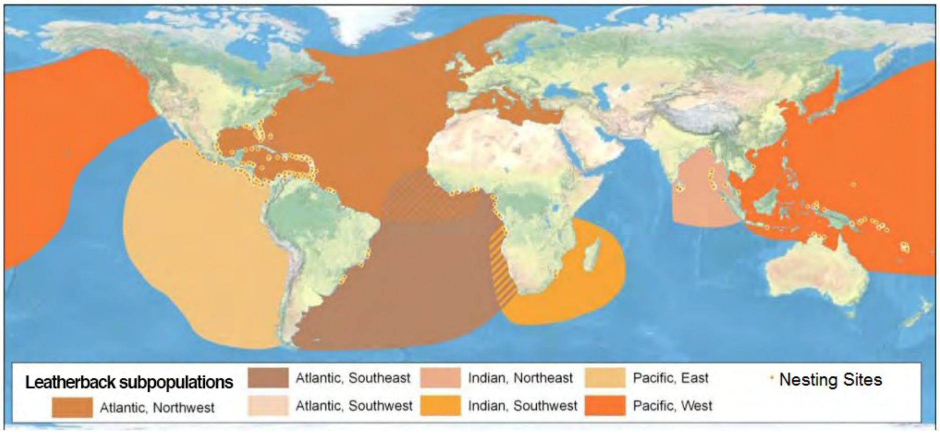

Figure 19. Map identifying the range of the endangered leatherback sea turtle. From NMFS http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.html, adapted from Wallace et al. (2010).

Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their belly (Figure 20). The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (Table 10).

Figure 20. Leatherback turtle. Photo: R.Tapilatu

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Dermochelys coriacea	Leatherback sea turtle	None Designated	Endangered range wide	2013	35 FR 8491	1991 (U.S. Caribbean, Atlantic, and Gulf of Mexico); 1998 (Pacific)	44 FR 17710 and 77 FR 4170

Table 10. Leatherback turtle information.

We used information available in the five year review (NMFS and USFWS 2013), the critical habitat designation (44 FR 17710), and recent nesting data from the Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

Life History
Age at maturity has been difficult to ascertain, with estimates ranging from five to 29 years (Avens *et al.* 2009, Spotila *et al.* 1996). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing greater than 80 grams (Reina *et al.* 2002, Wallace *et al.* 2007). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50% worldwide (Eckert *et al.* 2012). Females nest every one to seven years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James *et al.* 2005b, Wallace *et al.* 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000, Price *et al.* 2004).

Population Dynamics
The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the leatherback sea turtle.

Leatherbacks are globally distributed, with nesting beaches in the Pacific, Atlantic, and Indian oceans. Detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila *et al.* 2000). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS and USFWS 2013).

Population growth rates for leatherback sea turtles vary by ocean basin. Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation has been declining at a rate of almost 6% per year since 1984 (Tapilatu *et al.* 2013). Leatherback nesting in the Northwest Atlantic is also showing an overall negative trend, with the most notable decrease occurring during the most recent time frame of 2008-2017 (Wallace and Eckert 2018). From 1989-2018, leatherback nests at core index beaches in Florida have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014. Since 2014, leatherback nest numbers on Florida beaches have been declining (Figure 21).

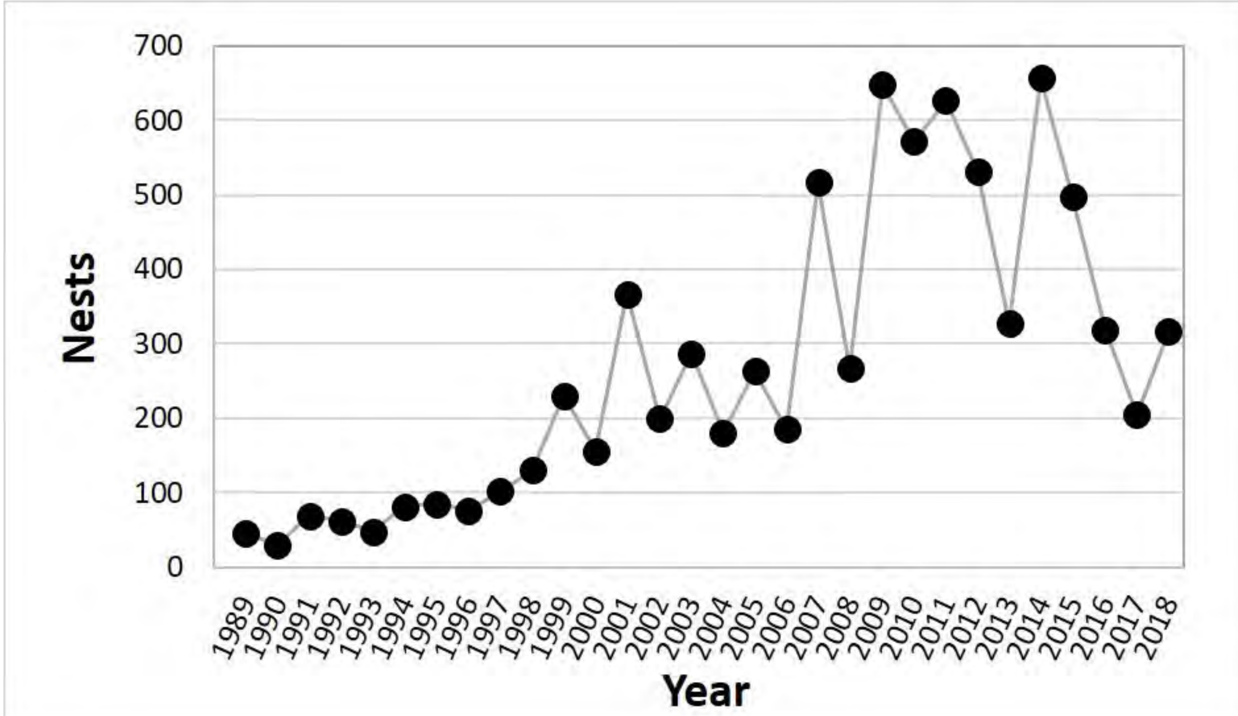

Figure 21. Number of leatherback sea turtle nests counted on core index beaches in Florida from 1989-2018. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

Analyses of mitochondrial DNA from leatherback sea turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton *et al.* 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS and USFWS 2013).

Leatherback sea turtles are distributed in oceans throughout the world. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson *et al.* 2011).

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, because of sea-level rise. The species' resilience to additional perturbation is low.

Recovery Goals
See the 1998 and 1991 Recovery Plans for the U.S. Pacific and U.S Caribbean, Gulf of Mexico and Atlantic leatherback sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan:

1. Reduce fisheries interactions
2. Improve nesting beach protection and increase reproductive output
3. International cooperation
4. Monitoring and research
5. Public engagement

4.2.2 Atlantic Sturgeon

Species description
Atlantic sturgeon are a long-lived (i.e., up to 64 years), late maturing, estuarine-dependent anadromous species (ASSRT 2007, Balazik *et al.* 2010, Hilton *et al.* 2016, Sulak and Randall 2002). They occupy ocean and estuarine waters including sounds, bays, and tidal-affected rivers from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASSRT 2007) (Figure 22). Atlantic sturgeon are bluish black or olive brown dorsally and white ventrally, and have five major rows of dermal scutes (Colette and Klein-MacPhee 2002). The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 meters (14 feet) (Vladykov and Greeley 1963). A sturgeon detected in the Hudson River in 2018 by sonar scanning was estimated to be 14 feet long (Figura 2019, Revkin 2019). On February 6, 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (77 FR 5880 and 77 FR 5914). The Gulf of Maine DPS is listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered (Table 11).

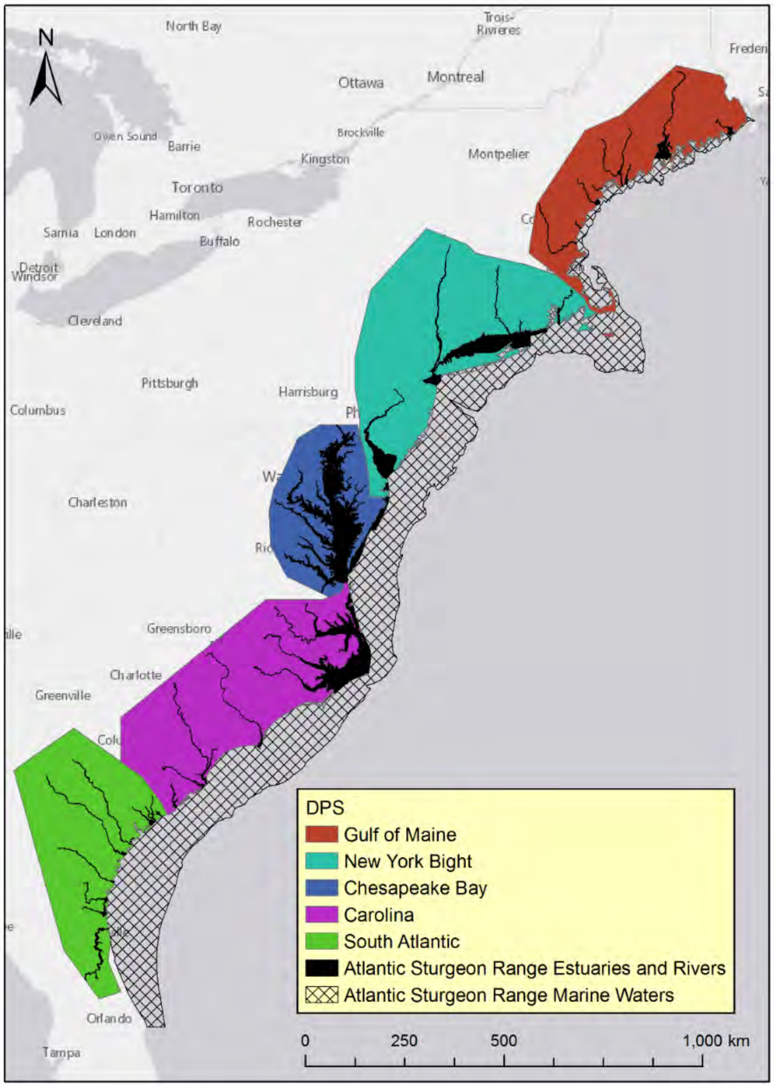

Figure 22. Range of all five Atlantic sturgeon DPSs.

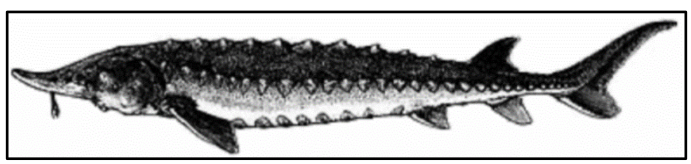

Figure 23. Adult Atlantic sturgeon.

Table 11. Atlantic sturgeon information bar provides species' Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Gulf of Maine (GOM)	Threatened	2007	77 FR 5880	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	New York Bight (NYB)	Endangered	2007	77 FR 5880	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Chesapeake Bay (CB)	Endangered	2007	77 FR 5880	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	Carolina	Endangered	2007	77 FR 5914	No	82 FR 39160
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	South Atlantic (SA)	Endangered	2007	77 FR 5914	No	82 FR 39160

Information available from the 2007 Atlantic sturgeon status review (ASSRT 2007), 2017 ASMFC benchmark stock assessment (ASMFC 2017), final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), as well as material supporting the designation of Atlantic sturgeon critical habitat (NMFS 2017b), were used to summarize the life history, population dynamics, and status of the species.

Life history

As noted above, Atlantic sturgeon are a late maturing, anadromous species (ASSRT 2007, Balazik *et al.* 2010, Hilton *et al.* 2016, Sulak and Randall 2002). Sexual maturity is reached between the ages of 5 to 34 years, with sturgeon originating from rivers in lower latitudes (*e.g.*, South Carolina rivers) maturing faster than those originating from rivers located in higher latitudes (e.g., Saint Lawrence River) (NMFS 2017b).

Atlantic sturgeon spawn in freshwater (ASSRT 2007, NMFS 2017b) above the salt front of the river, at sites characterized by flowing water, and consisting of hard bottom substrate (Bain *et al.* 2000, Balazik *et al.* 2012a, Caron *et al.* 2002, Collins *et al.* 2000, Gilbert 1989, Greene *et al.* 2009, Hager *et al.* 2014, Hatin *et al.* 2002, Mohler 2003, Scott and Crossman 1973, Smith and Clugston 1997, Vladykov and Greeley 1963). Water depths of spawning sites are highly variable, but may be up to 27 meters (Bain *et al.* 2000, Crance 1987, Leland 1968, Scott and Crossman 1973). Based on tagging records, Atlantic sturgeon return to their natal rivers to spawn (ASSRT 2007), with spawning intervals ranging from one to five years in males (Caron *et* *al.* 2002, Collins *et al.* 2000, Smith 1985) and two to five years for females (Stevenson and Secor 1999, Van Eenennaam *et al.* 1996, Vladykov and Greeley 1963). Based on new and historical sources of information, some Atlantic sturgeon river populations may have up to two spawning seasons (spring and/or fall) comprised of different spawning adults (Balazik and Musick 2015, Dovel and Berggren 1983).[2] There is evidence of fall spawning for the Carolina and South Atlantic DPSs (Collins *et al.* 2000, NMFS and USFWS 1998b, Smith *et al.* 1984); spring (March through May) and fall (August through November) spawning for the Chesapeake Bay DPS (Balazik *et al.* 2012a, Hager *et al.* 2014, Kahn *et al.* 2014); and spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS 2017a).

Following spawning, males move downriver to the lower estuary and remain there until outmigration in the fall (Bain 1997, Bain *et al.* 2000, Balazik *et al.* 2012a, Breece *et al.* 2013, Collins *et al.* 2000, Dovel and Berggren 1983, Greene *et al.* 2009, Hatin *et al.* 2002, Smith 1985, Smith *et al.* 1982). Females move downriver and may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Bain 1997, Bain *et al.* 2000, Balazik *et al.* 2012a, Breece *et al.* 2013, Collins *et al.* 2000, Dovel and Berggren 1983, Greene *et al.* 2009, NMFS 2017a, Smith 1985, Smith *et al.* 1982). Eggs which are deposited on hard bottom substrate, hatch into the yolk sac larval stage approximately 94 to 140 hours after egg deposition (Mohler 2003, Murawski and Pacheco 1977, Smith *et al.* 1980, Theodore *et al.* 1980, Van Den Avyle 1984, Vladykov and Greeley 1963). During the larval stage, larvae tend to congregate in low salinity (*i.e.*, freshwater) rearing grounds, which are either co-located with or are downstream of the spawning grounds (Kynard and Horgan 2002, Mohler 2003). Once the yolk sac is absorbed (eight to ten days post-hatching), sturgeon are considered juveniles. This stage can last months to years in the brackish waters of the natal estuary (ASSRT 2007, Calvo *et al.* 2010, Collins *et al.* 2000, Dadswell 2006, Dovel and Berggren 1983, Greene *et al.* 2009, Hatin *et al.* 2007, Holland and Yelverton 1973, Kynard and Horgan 2002, Mohler 2003, NMFS 2017b, Schueller and Peterson 2010, Secor *et al.* 2000, Shirey *et al.* 1997, Waldman *et al.* 1996a). Upon reaching the subadult phase, individuals enter the marine environment, mixing with adults and subadults from other river systems (Bain 1997, Dovel and Berggren 1983, Hatin *et al.* 2007, McCord *et al.* 2007, NMFS 2017b). Once subadult Atlantic sturgeon have reached maturity/the adult stage, they will remain in marine or estuarine waters, only returning far upstream within their natal rivers to spawn (ASSRT 2007, Bain 1997, Breece *et al.* 2016, Collins *et al.* 1996, Dunton *et al.* 2012, Dunton *et al.* 2015, Savoy and Pacileo 2003).

Population dynamics

Abundance

A population estimate was derived from the Northeast Area Monitoring and Assessment Program (NEAMAP) trawl surveys.[3] For this Opinion, we are relying on the population

2 Although referred to as spring spawning and fall spawning, the actual time of Atlantic sturgeon spawning may not occur during the astronomical spring or fall season (Balazik and Musick 2015).

3 Since fall 2007, NEAMAP trawl surveys (spring and fall) have been conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 18.3 meters (60 feet). Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations.

estimates derived from the NEAMAP swept area biomass assuming a 50% catchability (*i.e.*, net efficiency x availability) rate. We consider that the NEAMAP surveys sample an area utilized by Atlantic sturgeon, but do not sample all the locations and times where Atlantic sturgeon are present, and that the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Therefore, we assume that net efficiency and the fraction of the population exposed to the NEAMAP surveys in combination result in a 50% catchability (NMFS 2013). The 50% catchability assumption reasonably accounts for the robust, yet not complete sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear. As these estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date, we believe these estimates continue to serve as the best available information. Based on the above approach, the overall abundance of Atlantic sturgeon in U.S. Atlantic waters is estimated to be 67,776 fish (Kocik *et al.* 2013). Based on genetic frequencies of occurrence in the sampled area, this overall population estimate was subsequently partitioned by DPS (Table 12). Given the proportion of adults to subadults in the observer database (approximate ratio of 1:3), we have also estimated the number of adults and subadults originating from each DPS. However, this cannot be considered an estimate of the total number of subadults because it only considers those subadults that are of a size that are present and vulnerable to capture in commercial trawl and gillnet gear in the marine environment.

It is important to note, the NEAMAP-based estimates do not include young-of-the-year (YOY) fish and juveniles in the rivers; however, those segments of the Atlantic sturgeon populations are at minimal risk from the proposed action since they are absent within the action area. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of subadult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. However, the estimated number of subadults in marine waters is a minimum count because it only considers those subadults: (1) captured in a portion of the action area, (2) that are of a size vulnerable to capture in otter trawl gear, and (3) are also present in the marine environment, which is only a fraction of the total number of subadults. In regards to adult Atlantic sturgeon, the estimated population in marine waters is also a minimum count as the NEAMAP surveys sample only a portion of the action area, and therefore a portion of the Atlantic sturgeon's range.

Table 12. Summary of calculated population estimates based upon the NEAMAP survey swept area model assuming 50% efficiency.

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591
NYB	34,566	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada	678	170	509

Population Growth Rate

Precise estimates of population growth rate (intrinsic rates) are unknown for the five listed DPSs of Atlantic sturgeon due to a lack of long-term abundance data. The ASMFC (2017) stock assessment referenced a population viability assessment (PVA) that was done to determine population growth rates for the five DPSs based on a few long-term survey programs, but most results were statistically insignificant or utilized a model that would not converge. In any event, the population growth rates reported from that PVA ranged from -1.8% to 4.9% (ASMFC 2017).

Genetic Diversity

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (ASSRT 2007, Bowen and Avise 1990, O'Leary *et al.* 2014, Ong *et al.* 1996, Waldman *et al.* 1996b, Waldman and Wirgin 1998). Overall, these studies have consistently found populations to be genetically diverse, and the majority can be readily differentiated. Relatively low rates of gene flow reported in population genetic studies (Fritts *et al.* 2016, Savoy *et al.* 2017, Wirgin *et al.* 2002) indicate that Atlantic sturgeon return to their natal river to spawn, despite extensive mixing in coastal waters.

Determination of Atlantic sturgeon DPS Composition in the Action Area

The range of all five Atlantic sturgeon DPSs overlaps and extends from Canada through Cape Canaveral, Florida. All five DPSs are present in and use the action area. We decided to not use the most recent published mixed stock analysis from Wirgin *et al.* (2015b), because the percentages were based on genetic sampling of individuals captured during observed fishing trips from Maine through North Carolina. Instead, we use the percentages from O'Leary *et al.* (2014) because their sampling area is more consistent in habitat and geography to the action area defined in this Opinion. Based on a recent mixed stock analysis done by O'Leary *et al.* (2014), we expect Atlantic sturgeon throughout the action area originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2%. These percentages are based on genetic sampling of all individuals (n=460) captured during trawl surveys in the mid-Atlantic Bight as described in (2012), Dunton *et al.* (2010). Individuals were captured at coastal aggregation sites for Atlantic sturgeon off the coast of Rockaway Peninsula, New York in May/June 2010, May 2011, October/November 2011, and May 2012. The genetic assignments have corresponding confidence intervals; however, for purposes of this Opinion, we are using the reported values without their associated confidence intervals. The reported values, which approximate the mid-point of the range, are a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in O'Leary *et al.* (2014).

Distribution

Depending on life stage, sturgeon may be present in marine and estuarine ecosystems. The action area for this Opinion occurs in marine waters; therefore, this section will focus only on the distribution of Atlantic sturgeon life stages (subadult and adult) in marine waters; it will not discuss the distribution of Atlantic sturgeon life stages (eggs, larvae, juvenile, subadult, adult) in freshwater ecosystems, specifically, their movements into/out of natal river systems. For information on Atlantic sturgeon distribution in freshwater ecosystems, refer to: (ASMFC 2017, ASSRT 2007, NMFS 2017b).

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. As Atlantic sturgeon travel long distances in these waters, all five DPSs of Atlantic sturgeon have the potential to be anywhere in this marine range. Results from genetic studies show that, regardless of location, multiple DPSs can be found at any one location along the Northwest Atlantic coast, although the Hudson River population from the New York Bight DPS dominates (ASMFC 2017, ASSRT 2007, Dadswell 2006, Dadswell *et al.* 1984, Dovel and Berggren 1983, Dunton *et al.* 2012, Dunton *et al.* 2015, Dunton *et al.* 2010, Erickson *et al.* 2011, Kynard *et al.* 2000, Laney *et al.* 2007, O'Leary *et al.* 2014, Stein *et al.* 2004b, Waldman *et al.* 2013, Wirgin *et al.* 2015a, Wirgin *et al.* 2015b, Wirgin *et al.* 2012).

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 50 meter depth contour (Dunton *et al.* 2012, Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, O'Leary *et al.* 2014, Stein *et al.* 2004a, b, Waldman *et al.* 2013, Wirgin *et al.* 2015a, Wirgin *et al.* 2015b). However, they are not restricted to these depths and excursions into deeper (*e.g.*, 75 m) continental shelf waters have been documented (Colette and Klein-MacPhee 2002, Collins and Smith 1997, Dunton *et al.* 2010, Erickson *et al.* 2011, Stein *et al.* 2004a, b, Timoshkin 1968). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Dunton *et al.* 2010, Erickson *et al.* 2011, Hilton *et al.* 2016, Oliver *et al.* 2013, Post *et al.* 2014, Wippelhauser 2012). For instance, studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 20 m, during winter and spring; while, in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 20 meters (Erickson *et al.* 2011).

In the marine range, several marine aggregation areas occur adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (*i.e.*, waters off North Carolina, Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries). Depths in these areas are generally no greater than 25 meters (Bain *et al.* 2000, Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, O'Leary *et al.* 2014, Oliver *et al.* 2013, Savoy and Pacileo 2003, Stein *et al.* 2004b, Waldman *et al.* 2013, Wippelhauser 2012, Wippelhauser and Squiers 2015). Although additional studies are still needed to clarify why Atlantic sturgeon aggregate at these sites, there is some indication that they may serve as thermal refuge, wintering sites, or marine foraging areas (Dunton *et al.* 2010, Erickson *et al.* 2011, Stein *et al.* 2004b).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 (ASSRT 2007). Individuals are currently present in 35 rivers and are probably present in additional rivers that provide sufficient forage base, depth, and access (ASSRT 2007). The benchmark stock assessment evaluated evidence for spawning tributaries and sub-populations of U.S. Atlantic sturgeon in 39 rivers. They confirmed (eggs, embryo, larvae, or YOY observed) spawning in ten rivers, considered spawning highly likely (adults expressing gametes, discrete genetic composition) in nine rivers, and suspected (adults observed in upper reaches of tributaries, historical accounts, presence of resident juveniles) spawning in six rivers. Spawning in the remaining rivers was unknown (ten) or suspected historical (four) (ASMFC 2017). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery, which existed for the Atlantic sturgeon through the mid 1990s. In 1998, the ASMFC placed a 20-40 year moratorium on all Atlantic sturgeon fisheries until the spawning stocked could be restored to a level where 20 subsequent year classes of adult females were protected (ASMFC 1998a, b). In 1999, NMFS closed the Exclusive Economic Zone to Atlantic sturgeon retention, pursuant to the Atlantic Coastal Act (64 FR 9449; February 26, 1999). However, many state fisheries for sturgeon were closed prior to this.

The most significant threats to Atlantic sturgeon are incidental catch, dams that block access to spawning habitat in southern rivers, poor water quality, dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Climate change related impacts on water quality (*e.g.*, temperature, salinity, dissolved oxygen, contaminants) also have the potential to affect Atlantic sturgeon populations using impacted river systems.

In support of the above, the ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017). Based on historic removals and estimated effective population size, the 2017 stock assessment concluded that Atlantic sturgeon are depleted relative to historical levels. However, the 2017 stock assessment does provide some evidence of population recovery at the coastwide scale, and mixed population recovery at the DPS scale (ASMFC 2017). The 2017 stock assessment also concluded that a variety of factors (i.e., bycatch, habitat loss, and ship strikes) continue to impede the recovery rate of Atlantic sturgeon (ASMFC 2017).

4.2.2.1 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in at least the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT 2007). Spawning habitat is available and accessible in the Penobscot, Androscoggin, Kennebec, Merrimack, and Piscataqua (inclusive of the Cocheco and Salmon Falls rivers) rivers. Spawning has been documented in the Kennebec River. In the Androscoggin River, captures of adult Atlantic sturgeon, including a ripe male, over suitable spawning grounds during the spawning season confirm likely spawning; however Atlantic sturgeon eggs and larvae have not yet been recovered in the Androscoggin (Wippelhauser pers. comm. 2018). Despite the availability of suitable habitat and the presence of Atlantic sturgeon in the remaining rivers, there is currently no evidence spawning activity in these rivers.

Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT 2007, Fernandes *et al.* 2010).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (ASMFC 1998b, NMFS and USFWS 1998b). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15, 1980, through July 26, 1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least four ripe males and one ripe female captured on July 26, 1980; and, (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (ASMFC 2007, NMFS and USFWS 1998b). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon.

Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.* 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.* 1979). Following the 1880s, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon bycatch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (ASMFC 2007, Stein *et al.* 2004a). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast Fishery Management Plans (FMPs). At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date, we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

While there are dams on the Kennebec, Androscoggin, and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or or injured during passage at the dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The tracking of spawning condition Atlantic sturgeon downstream of the Brunswick Dam in the Androscoggin River suggests however, that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. Until it was breached in July 2013, the range of Atlantic sturgeon in the Penobscot River was limited by the presence of the Veazie Dam. Since the removal of the Veazie Dam and the Great Works Dam, sturgeon can now travel as far upstream as the Milford Dam. While Atlantic sturgeon are known to occur in the Penobscot River, there is no evidence that spawning is currently occurring. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (EPA 2008, Lichter *et al.* 2006). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no empirical abundance estimates for the Gulf of Maine DPS. The Atlantic sturgeon SRT (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

Summary of the Gulf of Maine DPS

Spawning for the Gulf of Maine DPS is known to occur in two rivers (Kennebec and Androscoggin). Spawning may be occurring in other rivers, such as the Penobscot, but has not been confirmed. There are indications of increasing abundance of Atlantic sturgeon belonging to the Gulf of Maine DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (*e.g.*, the Saco, Presumpscot, and Charles rivers). These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (*e.g.*, directed fishing), or reduced as a result of improvements in water quality and removal of dams (*e.g.*, the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC 2007). Atlantic sturgeon from the Gulf of Maine DPS are not commonly taken as bycatch in areas south of Chatham, Massachusetts, with only 8 percent (*e.g.*, 7 of 84 fish) of interactions observed in the New York region being assigned to the Gulf of Maine DPS (Wirgin and King 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south.

However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.* 2012). Thus, a significant number of the GOM DPS fish appear to migrate north into Canadian waters where they may be subjected to a variety of threats including bycatch.

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (ASMFC 2007, Boreman 1997, Brown and Murphy 2010, Kahnle *et al.* 2007). We have determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (*i.e.*, is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

4.2.2.2 New York Bight DPS of Atlantic sturgeon

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (ASSRT 2007, Murawski and Pacheco 1977, Secor 2002). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning Taunton River (ASSRT 2007). However, there is recent evidence that spawning may be occurring in the Connecticut River. Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT 2007, Savoy 2007, Wirgin and King 2011).

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded over-exploitation in the 1800s is unknown but, has been conservatively estimated at 10,000 adult females (Secor 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (ASSRT 2007, Kahnle *et al.* 2007, Secor 2002). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). Kahnle *et al.* (2007, 1998) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. A decline in the abundance of young Atlantic sturgeon appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (ASMFC 2010, Kahnle *et al.* 1998, Sweka *et al.* 2007). At the time of listing, catch-per-unit-effort (CPUE) data suggested that recruitment remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (ASMFC 2010, Sweka *et al.* 2007). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s while the CPUE is generally higher in the 2000s as compared to the 1990s. Given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. Standardized mean catch per net set from the NYSDEC juvenile Atlantic sturgeon survey have had a general increasing trend from 2006 – 2015, with the exception of a dip in 2013.

In addition to capture in fisheries operating in federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad) in the Hudson River, has now been closed and there is no indication that it will reopen soon. In the Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Individuals are also exposed to effects of bridge construction (including the replacement of the Tappan Zee Bridge). Impingement at water intakes, including the Danskammer, Roseton and Indian Point power plants also occurs. Recent information from surveys of juveniles indicates that the number of young Atlantic sturgeon in the Hudson River is increasing compared to recent years, but is still low compared to the 1970s. There is currently not enough information regarding any life stage to establish a trend for the entire Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor 2002, Secor and Waldman 1999). Sampling in 2009 to target young-of-the-year (YOY) Atlantic sturgeon in the Delaware River (*i.e.*, natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher 2009), and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron 2009, Calvo *et al*. 2010). Genetics information collected from 33 of the 2009 year class YOY indicates that at least three females successfully contributed to the 2009 year class (Fisher 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River; however, at this time, we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

New information is available that better informs the marine range of the New York Bight DPS, and the marine distribution of Atlantic sturgeon belonging to the New York Bight. Based on genetic analyses, Atlantic sturgeon belonging to the New York Bight DPS have been identified among those captured in the Bay of Fundy, Long Island Sound, the lower Connecticut River, in marine waters off of western Long Island, New Jersey, Delaware, Virginia, and North Carolina. However, the New York Bight DPS was more prevalent relative to the other DPSs in Mid-Atlantic marine waters, bays, and sounds (Waldman *et al.* 2013, Wirgin *et al.* 2015a, Wirgin *et* *al.* 2015b, Wirgin *et al.* 2018). These findings support the conclusion of Wirgin *et al.* (2015b) that natal origin influences the distribution of Atlantic sturgeon in the marine environment, and suggest that some parts of its marine range are more useful to and perhaps also essential to the New York Bight DPS.

Further evidence was presented by Erickson *et al.* (2011). Thirteen of the fifteen adult Atlantic sturgeon, that they captured and tagged in the tidal freshwater reach of the Hudson River (i.e., belonging to the Hudson River spawning population), remained in the Mid-Atlantic Bight during the 6 months to 1 year time period of data collection. Of the remaining two fish, one traveled as far north as Canadian waters where its tag popped up in June, nearly one year after being tagged. The second fish traveled south beyond Cape Hatteras[4] before its tag popped up, about 7 months after being tagged. Collectively, all of the tagged sturgeon occurred in marine and estuarine Mid-Atlantic Bight aggregation areas that have been the subject of sampling used for the genetic analyses, including in waters off of Long Island, the coasts of New Jersey and Delaware, the Delaware Bay and the Chesapeake Bay.

Breece *et al.* (2016) further investigated the distribution and occurrence of Atlantic sturgeon in the Mid-Atlantic Bight based on associated habitat features, as well as the habitat features associated with presence of adults in the Delaware River, and their distribution and movements within Delaware Bay. The research provides evidence of specific, dynamic habitat features that Atlantic sturgeon are sensitive to in their aquatic environments such as substrate composition and distance from the salt front in the river estuary, water depth and water temperature in Delaware Bay, and depth, day-of-year, sea surface temperature, and light absorption by seawater in marine waters (Breece *et al.* 2017, Breece *et al.* 2018, Breece *et al.* 2013). Their model, based on the features identified for the marine environment, was highly predictive of Atlantic sturgeon distribution in the Mid-Atlantic Bight from mid-April through October. Since the majority of Atlantic sturgeon occurring in the Mid-Atlantic Bight belong to the New York Bight DPS, these studies provide: (1) new information describing the environmental factors that influence the presence and movements of New York Bight DPS Atlantic sturgeon in the Mid-Atlantic Bight, the Delaware Bay and the Delaware River; (2) a modeling approach for predicting occurrence and distribution of New York Bight DPS Atlantic sturgeon, particularly in the spring through early fall; and, (3) information to better assess effects to the New York Bight DPS given known, expected, or predicted changes to their habitat.

Summary of the New York Bight DPS

Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware River, the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (ASMFC 2009). Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (*e.g.*, directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been

4 As explained in Erickson *et al.* (2011), relocation data for both of these fish were more limited for different reasons. Therefore, more exact locations could not be determined.

reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (ASMFC 2007, Stein *et al.* 2004b). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid-Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS (Wirgin *et al.* 2012). At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities, many do not. We have reports of Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and four fish were entrained in the Delaware River during maintenance and deepening activities in 2017 and 2018. At this time, we do not have any additional information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (EPA 2008, Lichter *et al.* 2006). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. Additionally, 138 sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and 2015. Of these, 69 are suspected of having been killed by vessel strike. Genetic analysis has not been completed on any of these individuals to date, given that the majority of Atlantic sturgeon in the Hudson River belong to the New York Bight DPS, we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (ASMFC 2007, Boreman 1997, Brown and Murphy 2010, Kahnle *et al.* 2007). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. We determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

4.2.2.3 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay (CB) DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. The marine range of Atlantic sturgeon from the CB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the CB DPS and the adjacent portion of the marine range are shown in Figure 22. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Based on the review by Oakley (2003), 100% of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (*i.e.*, dams) are located upriver of where spawning is expected to have historically occurred (ASSRT 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well, specifically within the Pamunkey River (a tributary of the York River) (ASSRT 2007, Greene *et al.* 2009, Musick *et al.* 1994). The recent capture of an adult sturgeon in spawning condition suggests that spawning may also occur in Marshyhope Creek, a tributary to the Nanticoke River (Horne and Stence 2016). However, conclusive evidence of current spawning is only available for the James River, where spring spawning occurs, and a study also found evidence of Atlantic sturgeon spawning in the fall (Balazik *et al.* 2012b). Atlantic sturgeon that are spawned elsewhere are known to use the Chesapeake Bay (ASSRT 2007, Grunwald *et al.* 2008, Vladykov and Greeley 1963, Wirgin *et al.* 2000).

Age to maturity for CB DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is five to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith *et al.* 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.* 1988). Therefore, age at maturity for Atlantic sturgeon of the CB DPS likely falls within these values.

Several threats play a role in shaping the current status of CB DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (ASMFC 1998a, ASSRT 2007, Bushnoe *et al.* 2005, Hildebrand and Schroeder 1928, Secor 2002, Vladykov and Greeley 1963) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (ASSRT 2007, Balazik *et al.* 2010, Bushnoe *et al.* 2005, Secor 2002). Habitat disturbance caused by in-river work, such as dredging for navigational purposes, is thought to have reduced available spawning habitat in the James River (ASSRT 2007, Bushnoe *et al.* 2005, Holton and Walsh 1995). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the CB DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (ASMFC 1998b, ASSRT 2007, EPA 2008, Pyzik *et al.* 2004). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor 2005, 2010). Heavy industrial development during the 20th century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery.

Although there have been improvements in the some areas of the Bay's health, the ecosystem remains in poor condition. The EPA gave the overall health of the Bay a grade of 45% based on goals for water quality, habitats, lower food web productivity, and fish and shellfish abundance (EPA CBP 2010). This was a 6% increase from 2008. According to the EPA, the modest gain in the health score was due to a large increase in the adult blue crab population, expansion of underwater grass beds growing in the Bay's shallows, and improvements in water clarity and bottom habitat health as highlighted below:

- 12% of the Bay and its tidal tributaries met CWA standards for dissolved oxygen between 2007 and 2009, a decrease of 5% from 2006 to 2008,
- 26% of the tidal waters met or exceeded guidelines for water clarity, a 12% increase from 2008,
- Underwater bay grasses covered 9,039 more acres of the Bay's shallow waters for a total of 85,899 acres, 46% of the Bay-wide goal,
- The health of the Bay's bottom dwelling species reached a record high of 56% of the goal, improving by approximately 15% Bay-wide, and
- The adult blue crab population increased to 223 million, its highest level since 1993.

At this time we do not have sufficient information to quantify the extent that degraded water quality effects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005-2007. Several of these were mature individuals. Balazik *et al.* (2012c) found 31 carcasses in tidal freshwater regions of the James River between 2007 and 2010, and approximately 36 between 2013 and 2017 (Balazik, pers comm). Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the CB DPS on a regular basis. However, Balazik et al. estimates that current monitoring in the James River only captures approximately one third of all mortalities related to vessel interaction.

In the marine and coastal range of the CB DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (ASMFC 2007, ASSRT 2007, Stein *et al.* 2004a).

Summary of the Chesapeake Bay DPS
Spawning for the CB DPS is known to occur in only the James and Pamunkey Rivers. Spawning may be occurring in other rivers, such as the York, Rappahannock, Potomac, and Nanticoke, but has not been confirmed for any of those. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James River or to provide sufficient evidence to confirm increased abundance. Some of the impact from the threats that facilitated the decline of the CB DPS have been removed (*e.g.*, directed fishing) or reduced as a result of improvements in water quality since passage of the CWA. We have estimated that there are a minimum of 8,811 CB DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries, and vessel strikes remain significant threats to the CB DPS of Atlantic sturgeon. Of the 35% of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were CB DPS fish (Wirgin *et al.* 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (ASMFC 2007, Boreman 1997, Kahnle *et al.* 2007). The CB DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

4.2.2.4 Carolina DPS of Atlantic sturgeon
The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern

Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the Carolina DPS and the adjacent portion of the marine range are shown in Figure 22. Sturgeon are commonly captured 40 miles offshore (D. Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (ASMFC 2007, Stein *et al.* 2004a), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if YOY were observed or mature adults were present in freshwater portions of a system (Table 13). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee, and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated, and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Table 13. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

River/Estuary	**Spawning Population**	**Data**
Roanoke River, VA/NC; Albemarle Sound, NC	Yes	collection of 15 YOY (1997-1998); single YOY (2005)
Tar-Pamlico River, NC; Pamlico Sound	Yes	one YOY (2005)
Neuse River, NC; Pamlico Sound	Unknown	
Cape Fear River, NC	Yes	upstream migration of adults in the fall, carcass of a ripe female upstream in mid-September (2006)
Waccamaw River, SC; Winyah Bay	Yes	age-1, potentially YOY (1980s)
Pee Dee River, SC; Winyah Bay	Yes	running ripe male in Great Pee Dee River (2003)
Sampit, SC; Winyah Bay	Extirpated	
Santee River, SC	Unknown	
Cooper River, SC	Unknown	
Ashley River, SC	Unknown	

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time frame. Prior reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with potential extirpation in an additional system. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, are estimated to be less than 3% of what they were historically (ASSRT 2007). We have estimated that there are a minimum of 1,356 Carolina DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast in the mid- to late 19th century, from which they have never rebounded. Continued bycatch of Atlantic sturgeon in commercial fisheries is an ongoing impact to the Carolina DPS. More robust fishery independent data on bycatch are available for the Northeast and Mid-Atlantic than in the Southeast where high levels of bycatch underreporting are suspected.

Though there are statutory and regulatory provisions that authorize reducing the impact of dams on riverine and anadromous species, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (*e.g.*, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.).

Summary of the Status of the Carolina DPS of Atlantic Sturgeon

Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of more than 60% of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and dissolved oxygen) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (*e.g.*, exposure to toxins). This may result in either reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the Carolina DPS have been ameliorated or reduced due to existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alterations are currently not being addressed through existing mechanisms. Further, despite NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources, access to habitat and improved water quality continues to be a problem. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the Carolina DPS.

4.2.2.5 South Atlantic DPS of Atlantic sturgeon

The South Atlantic (SA) DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the SA DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the SA DPS and the adjacent portion of the marine range are shown in Figure 22. Sturgeon are commonly captured 40 miles offshore (D. Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (ASMFC 2007, Stein *et al.* 2004a), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms (900 meters).

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if YOY were observed, or mature adults were present, in freshwater portions of a system (Table 14). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations at one time; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. Recent evidence shows that a small number of fish have returned to the St. Mary's River, and may use the river for spawning. Both the St. Marys and St. Johns Rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the SA DPS likely use other river systems than those listed here for their specific life functions.

Table 14. Major rivers, tributaries, and sounds within the range of the SA DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

River/Estuary	**Spawning Population**	**Data**
ACE (Ashepoo, Combahee, and Edisto Rivers) Basin, SC; St. Helena Sound	Yes	1,331 YOY (1994-2001); gravid female and running ripe male in the Edisto (1997); 39 spawning adults (1998)
Broad-Coosawhatchie Rivers, SC; Port Royal Sound	Unknown	
Savannah River, SC/GA	Yes	22 YOY (1999-2006); running ripe male (1997)
Ogeechee River, GA	Yes	age-1 captures, but high inter-annual variability (1991-1998); 17 YOY (2003); 9 YOY (2004)
Altamaha River, GA	Yes	74 captured/308 estimated spawning adults (2004); 139 captured/378 estimated spawning adults (2005)
Satilla River, GA	Yes	4 YOY and spawning adults (1995-1996)
St. Marys River, GA/FL	Extirpated	
St. Johns River, FL	Extirpated	

Secor (2002) estimates that 8,000 adult females were present in South Carolina before the collapse of the fishery in 1890. However, because fish from South Carolina are included in both the Carolina and SA DPSs, it is likely that some of the historical 8,000 fish would be attributed to both the Carolina DPS and SA DPS. The sturgeon fishery had been the third largest fishery in Georgia. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. We have estimated that there are a minimum of 14,911 SA DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

The directed Atlantic sturgeon fishery caused initial severe declines in southeast Atlantic sturgeon populations. Although the directed fishery is closed, bycatch in other commercial fisheries continues to impact the SA DPS. Statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species such as Atlantic sturgeon, but these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the SA DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (*e.g.*, no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon
Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the SA DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the SA DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality and dissolved oxygen are also contributing to the status of the SA DPS, particularly during times of high water temperatures, which increase the detrimental effects on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch also contributes to the SA DPSs status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (*e.g.*, exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the SA DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alteration are currently not being addressed through existing mechanisms. Further, access to habitat and good water quality continues to be a problem even with NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Existing water allocation issues will likely be compounded by population growth, drought, and, potentially, climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the SA DPS.

Recovery Goals
Recovery Plans have not yet been drafted for any of the Atlantic sturgeon DPSs. A recovery outline (see https://www.fisheries.noaa.gov/resource/document/recovery-outline-atlantic-sturgeon-distinct-population-segments) has been developed as interim guidance to direct recovery efforts, including recovery planning, until a full recovery plan is approved.

5 ENVIRONMENTAL BASELINE
The Environmental Baseline for biological opinions refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in

the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR § 402.02).

The environmental baseline for this Opinion includes the consequences of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, vessel and fishery operations, water quality/pollution, and recovery activities associated with reducing those impacts.

5.1 Dredging, Sand Mining, & Beach Nourishment

New York and New Jersey Harbor Deepening Project (HDP)
An Opinion regarding the HDP was issued by NMFS to the USACE on October 13, 2000 (NMFS 2000). The Opinion included an Incidental Take Statement (ITS) exempting the incidental taking of two loggerhead, one green, one Kemp's ridley, or one leatherback sea turtle for the duration (*i.e.*, three years) of the deepening, via a hopper dredge, of the Ambrose Channel. Consultation was reinitiated in 2012 and an Opinion was issued on October 25, 2012. The project was believed to be completed in 2014. The Opinion included an ITS exempting the incidental taking of one Kemp's ridley, or one leatherback, and one Atlantic sturgeon (any DPS) for the duration of the deepening, via a hopper dredge, of the Ambrose Channel. To date, no adverse impacts to listed species have been reported as a result of the HDP. This project is currently in the very early stages of reinitiation.

Amboy Aggregate Mining of Ambrose Channel
On October 11, 2002, NMFS issued an Opinion that considered the effects of the USACE's proposed issuance of a permit to Amboy Aggregates, Inc. for sand mining activities in the Ambrose Channel, New Jersey. The permit authorizes sand mining activities every year for a period of ten years. NMFS concluded that the proposed action may adversely affect, but would not likely jeopardize the continued existence of listed species of sea turtles. The 2002 Opinion included an ITS which exempted the take, via injury or mortality, of two loggerhead, one green, one Kemp's ridley, or one leatherback sea turtle for the ten year duration of the permit. On July 23, 2012, the USACE started coordination to reinitate this consultation to re-authorize the project for another 10 years. On May 20, 2013, NMFS concluded that the re-authorization of the project was not likely to adversely affect ESA-listed species. Therefore, this project currently no longer has an ITS. To date, no takes of listed species have been recorded.

Quogue Borrow Area Dredging and Beach Nourishment
On October 21, 2015, NMFS issued a letter of concurrence that considered the effects of the USACE's proposed issuance of a permit to the Incorporated Village of Quogue to conduct borrow dredging and beach nourishment with one additional dredging/nourishment event over

ten years. The dredge site is located approximately two miles offshore of the Village of Quogue in Suffolk County, New York. NMFS concurred that the project may affect but is not likely to adversely affect Atlantic sturgeon, the four species of sea turtles, and fin, humpback, and North Atlantic right whales.

Mecox Bay Inlet Dredging
On March 29, 2016, NMFS issued a letter of concurrence that considered the effects of the USACE's proposed issuance of a permit to the Board of Trustees of the Freeholders and Commonality of the Town of Southampton to perform dredging, with ten-year maintenance dredging, of Mecox Bay Inlet in Southampton, New York. NMFS concurred that the project may affect but is not likely to adversely affect Atlantic sturgeon and the four species of sea turtles.

Maintenance Dredging of Moriches Inlet
On May 2, 2018, NMFS concurred with a verification form under the Protected Resources Division – USACE North Atlantic Division 2017 NLAA Program for the dredging of the Federal Navigation Channel and deposition basin of Moriches Inlet in Suffolk County, New York. The project was scheduled to start on June 1, 2018, and was expected to end on August 30, 2018. NMFS concurred that the project may affect but is not likely to adversely affect Atlantic sturgeon, the four species of sea turtles, and fin and North Atlantic right whales.

Fire Island Beach Nourishment
On July 3, 2018, NMFS concurred with a verification form under the Protected Resources Division – USACE North Atlantic Division 2017 NLAA Program for the dredging of the Federal Navigation Channel and deposition basin of Fire Island Inlet at Gilgo Beach, New York. The project was scheduled to start on October 1, 2018, and was expected to end on April 1, 2019. NMFS concurred that the project may affect but is not likely to adversely affect Atlantic sturgeon, the four species of sea turtles, and fin and North Atlantic right whales.

Southampton Maintenance Dredge and Beach Placement
On September 17, 2018, NMFS concurred with a verification form under the Protected Resources Division – USACE North Atlantic Division 2017 NLAA Program for the dredging with ten-year maintenance of the connection between Sagaponack Pond and the Atlantic Ocean, with sidecasting of all resultant dredged material along the eastern and western shorelines of the excavated connection in Southampton, New York. The project was scheduled to start on October 1, 2018, and is expected to end on October l, 2028. NMFS concurred that the project may affect but is not likely to adversely affect Atlantic sturgeon and the four species of sea turtles.

5.2 Artificial Reefs

Atlantic Beach Reef and McAllister Grounds Reef
On June 5, 2019, NMFS concurred with two verification forms under the Protected Resources Division – USACE North Atlantic Division 2017 NLAA Program for the discharge of fill

material suitable for use as an artificial reef at the existing 413 acre Atlantic Beach Reef site and the 115 acre McAllister Grounds Reef site. The Atlantic Beach Reef site is located in the Atlantic Ocean approximately 3.2 nautical miles from Atlantic Beach in Long Beach, New York. The McAllister Grounds Reef site is located approximately 2.7 nautical miles from the city of Long Beach, New York. Both projects were scheduled to start on July 1, 2019, with 10-years maintenance, until July 1, 2029. NMFS concurred that the projects may affect but are not likely to adversely affect Atlantic sturgeon, the four species of sea turtles, and fin and North Atlantic right whales.

5.3 Federal Vessel Operations

Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the US Navy (USN) and the U.S. Coast Guard (USCG), which maintain the largest federal vessel fleets, the EPA, the National Oceanic and Atmospheric Administration (NOAA), and the USACE. NMFS has conducted formal consultations with the USCG, the USN, EPA and NOAA on their vessel operations. The USCG consultation authorizes the take of one sea turtle of any species per year. In addition to operation of USACE vessels, NMFS has consulted with the USACE to provide recommended permit restrictions for operations of contract or private vessels around whales. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. Refer to the biological opinions for the USCG (September 15, 1995 (NMFS 1995); July 22, 1996 (NMFS 1996); and June 8, 1998 (NMFS 1998)) and the USN (May 15, 1997) for details on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

5.4 Federally Authorized Fisheries

NMFS authorizes the operation of several fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation Act and through the FMP and their implementing regulations. Fisheries that operate in the action area that may affect sea turtles and Atlantic sturgeon include: Atlantic bluefish, Atlantic mackerel/squid/ butterfish, Atlantic sea scallop, monkfish, northeast multispecies, spiny dogfish, deep-sea red crab, and summer flounder/scup/black sea bass. Section 7 consultations have been completed on these fisheries to consider effects to sea turtles and Atlantic sturgeon.

5.4.1 Impacts to Sea Turtles

Each of the most recent NMFS Greater Atlantic Regional Fisheries Office (GARFO) and Southeast Regional Office (SERO) fishery consultations have considered adverse effects to green, Kemp’s ridley, loggerhead, and leatherback sea turtles. In each of the fishery Opinions, we concluded that the ongoing action was likely to adversely affect but was not likely to jeopardize the continued existence of any sea turtle species. Each of these Opinions included an ITS exempting a certain amount of lethal or non-lethal take resulting from interactions with the fisheries. These ITSs are summarized below (Table 15). Unless specifically noted, all numbers denote an annual number of captures that may be lethal or non-lethal.

Table 15. Most recent Opinions prepared by NMFS GARFO and SERO for federally managed fisheries in the action area and their respective ITSs for sea turtles. Unless noted, levels of incidental take exempted are on an annual basis.

GARFO FMPs	**Date**	**Loggerhead**	**Kemp's ridley**	**Green**	**Leatherback**
American lobster	July 31, 2014; formal consultation was reinitiated on October 17, 2017 (new BiOp is in progress)	1 (lethal or non-lethal)	0	0	7 (lethal or non-lethal)
Northeast Multispecies, Monkfish, Spiny Dogfish, Atlantic Bluefish, Northeast Skate Complex, Mackerel/Squid/Butterfish, and Summer Flounder/ Scup/Black Sea Bass (Batched Fisheries)	December 16, 2013 (ITS amended March 10, 2016); formal consultation was reinitiated on October 17, 2017 (new BiOp is in progress)	1,345 (835 lethal) over a 5 year period in gillnets; 1,020 (335 lethal) over a 5 year period in bottom trawls; 1 (lethal or non-lethal) in pot/trap gear	4 (3 lethal) in gillnets; 3 (2 lethal) in bottom trawls	4 (3 lethal) in gillnets; 3 (2 lethal) in bottom trawls	4 (3 lethal) in gillnets; 4 (2 lethal) in bottom trawls; 4 (lethal or non-lethal) in pot/trap gear
Atlantic sea scallop	July 12, 2012 (ITS amended November 27, 2018); formal consultation was reinitiated on February 14, 2020 (new BiOp is in progress)	322 (92 lethal) over a 2 year period in dredges; 700 (330 lethal) over a 5 year period in trawls	3 (2 lethal) in dredges and trawls combined	2 (lethal) in dredges and trawls combined	2 (lethal) in dredges and trawls combined
Red Crab	February 6, 2002; Formal consultation was reinitiated on October 17, 2017 (new BiOp is in progress)	1 (lethal or non-lethal)	0	0	1 (lethal or non-lethal)

The Northeast Fisheries Science Center (NEFSC) has estimated the take of sea turtles in gillnet, dredge, and trawl gear in the Greater Atlantic Region (Table 16). When available, these estimates were considered in developing the ITSs in the table above.

Table 16. Estimates of average annual turtle interactions in fishing gear. Numbers in parentheses are adult equivalents.

Gear	Years	Area	Estimated Interactions	Mortalities	Source
Sea Scallop Dredge	2009-2014	Mid-Atlantic	Loggerhead: 22 (2)	9-19* (1-2)	(Murray 2015a)
Sink Gillnet	2012-2016	Mid-Atlantic	Loggerhead: 141 (4) Kemp's ridley: 29 Leatherbacks: 5 Unid. hardshell: 22	Loggerhead: 112 Kemp's ridley: 23 Leatherbacks: 1 Unid. hardshell: 18	(Murray 2018)
Bottom Trawl	2009-2013	Mid-Atlantic	231 (33)	96 (14)	(Murray 2015b)
Bottom Trawl	2014-2018	Mid-Atlantic and Georges Bank	Loggerhead: 116 (36) Kemp's ridley:9 Green: 3 Leatherbacks: 5	Loggerhead: 54 (17) Kemp's ridley: 5 Green: 2 Leatherbacks:3	Murray, in press

*Nine to 19 of these interactions would result in mortality depending on whether loggerheads that interacted with chain mats without being captured (the unobservable but quantifiable interactions) survived.

Interactions of sea turtles are anticipated in state waters by vessels operating in the fishery Opinions listed in Table 15. Thus, the amount of incidental take of sea turtles that occurs in state waters by federal fisheries is a fraction of the amount exempted in those Opinions. However, the distribution and likelihood of sea turtle takes are highly variable such that interactions in nearshore and coastal waters in some years could be higher if greater fishing effort is expended (due to less travel time and ease of access to a wider range of vessels) or sea turtles are present in greater numbers in those waters. The amount of observer coverage allocated to nearshore versus offshore trips may also be a factor in how many sea turtle interactions are documented in certain waters for these fisheries.

5.4.2 Impacts to Atlantic Sturgeon

NMFS is in the process of reinitiating consultations that consider fisheries actions that may affect Atlantic sturgeon. Atlantic sturgeon are known to be captured and killed in fisheries operated in the action area; NMFS expects that interactions may occur in all of the fisheries noted above. Data in the Northeast Fisheries Observer Program (NEFOP) database (Miller and Shepard 2011) indicates that captures of Atlantic sturgeon in fishing gear has been reported in all months in area 612. In 2011, the NMFS Northeast Fisheries Science Center (NEFSC) prepared a bycatch estimate for Atlantic sturgeon captured in Federally managed commercial sink gillnet and otter trawl fisheries operated from Maine through Virginia. This estimate indicated that from 2006-2010, an annual average of 3,118 Atlantic sturgeon were captured in these fisheries with 1,569 in sink gillnet and 1,548 in otter trawls. The mortality rate in sink gillnets was estimated at approximately 20% and the mortality rate in otter trawls was estimated at 5%. Based on this estimate, a total of 391 Atlantic sturgeon were estimated to be killed annually in these fisheries that are prosecuted in the Greater Atlantic Region (Miller and Shepard 2011). Nearshore and coastal waters of the U.S. Northeast and Mid-Atlantic states represent a fraction of the action area assessed and for which interactions of Atlantic sturgeon are anticipated in the previous consultations for these fisheries.

Nonetheless, any Federal fisheries that use sink gillnets, otter trawls, or hook and line gear are likely to interact with Atlantic sturgeon and be an additional source of incidental take and mortality in the action area for this consultation. An updated, although unpublished Atlantic sturgeon bycatch estimate in Northeast sink gillnet and otter trawl fisheries for 2011-2015 was prepared by the NEFSC in 2016. Using this information, the authors of the recent Atlantic Sturgeon Benchmark Stock Assessment (ASMFC 2017) estimated that 1,139 fish (295 lethal; 25%) were caught in gillnet fisheries and 1,062 fish (41 lethal; 4%) were caught in otter trawl fisheries per year from 2000-2015. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from 2011-2015 (approximately 761 fish per year for gillnets, 777 for trawls) are substantially lower than those from 2006-2010 (approximately 1,074 fish per year for gillnets, 1,016 for trawls) (ASMFC 2017). NMFS is currently in the process of determining the effects of this annual loss to each of the DPSs.

5.5 Research Activities

NMFS Northeast Fisheries Science Center

We (NMFS NEFSC) provide funding to conduct a wide range of fisheries and ecosystem research activities along the U.S. Exclusive Economic Zone (EEZ) annually as part of our mission. In a June 23, 2016 programmatic Opinion, we concluded that the study may adversely affect, but were not likely to jeopardize the continued existence of the four sea turtle species and any DPS of Atlantic sturgeon. Among other species, the January 9, 2017 amended ITS exempted the take of up to 595 Atlantic sturgeon (30 lethal), 85 loggerhead turtles (10 lethal), 95 Kemp's ridley turtles (15 lethal), 10 green turtles, and 10 leatherback turtles (five lethal) over the next five years (and in future five-year periods).

Section 10(a)(1)(A) Permits

NMFS has issued research permits under section 10(a)(1)(A) of the ESA, which authorizes activities for scientific purposes or to enhance the propagation or survival of the affected species. The permitted activities do not operate to the disadvantage of the species and are consistent with the purposes of the ESA, as outlined in section 2 of the Act. The following section 10(a)(1)(A) permits are currently in effect for sea turtles and Atlantic sturgeon.

We searched for research permits on the NOAA Fisheries' online application system for Authorization and Permits for Protected Species (APPS) interactive website[5]. The search criteria used confined our search to active permits that include take of sea turtles and sturgeon in the coastal waters off of New York. There are currently eight research permits for sea turtles (Table 17) and three research permits for Atlantic sturgeon (Table 18) pursuant to 10(a)(1)(A) of the ESA. However, many research activities include a larger area of the Atlantic Ocean, and the requested take did not always specify the waters where take would occur. Thus, some of the requested take in the tables below include take for activities outside of the action area, *i.e.*, mid-

5 APPS website URL: https://apps.nmfs.noaa.gov/index.cfm

Atlantic coastal waters in general. The requested take reported here only includes take authorized under section 10(a)(1)(A) of the ESA. In addition, research projects may include take authorized under other authority, e.g., under section 7 of the ESA. These takes are presented elsewhere in this Opinion and, therefore, are not included here to avoid double counting of take provided under the ESA.

Table 17. Sea turtle section 10(a)(1)(A) permits within the action area.

Permittee	**File #**	**Project**	**Area**	**Sea Turtle Takes**	**Research Timeframe**
Coonamessett Farm Foundation, Inc.	18526	Understanding Impact of the Sea Scallop Fishery on Loggerhead Sea Turtles through Satellite Tagging	Western Atlantic waters / Mid-Atlantic Bight from Cape Hatteras, North to NY LIS; and from coastal waters to the shelf break.	<u>Non-lethal - Target species</u>: A maximum of 200 loggerhead (20 captured & sonic tagged/80 approached unsuccessfully & 100 observed and tracked with ROV). <u>Non-lethal - Non-target species</u>: Two Kemps ridley, green (captured & sonic tagged); 8 Kemp's ridley, green, leatherback, and/or unidentified (approached unsuccessfully); and 20 Kemp's ridley, green, leatherback, and unidentified (observed and tracked with ROV) sea turtles are requested per year.	05/27/2015 to 05/31/2020
NMFS Southeast Fisheries Science Center (SEFSC)	19627	SEFSC Observer Program Sea Turtle Research from Specimens taken in Commercial Fisheries in the Gulf of Mexico and off the East Coast of the United States, and Oil / Gas Platform Removal Programs in the Gulf of Mexico	Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and tributaries / Commercial Shrimp Trawl Fishery	<u>Non-lethal</u>: A maximum of 86 green, 571 loggerhead, 165 Kemp's ridley, 77 hawksbill, 253 leatherback, 20 olive ridley, and 14 combined species/unidentified/hybrid live turtles will be sampled. Sea turtles will be handled, identified, photographed, measured, weighed, flipper and passive integrated transponder (PIT) tagged, skin biopsied, and released.	01/10/2017 to 01/15/2022
NMFS NEFSC	20197	Biological sampling of incidentally caught sea turtles, during commercial fishing operations, by Northeast Fisheries Science Center (NEFSC) certified observers	Northwest Atlantic / Sea turtles incidentally caught during commercial fishing operations from state waters and the Exclusive Economic Zone in the Northwest Atlantic Ocean	<u>Non-lethal</u>: A maximum of 50 loggerhead, 10 Kemp's ridley, 10 green, 20 leatherback, and 20 unidentified sea turtles will be biologically sampled.	01/10/2017 to 01/15/2022
Atlantic Marine Conservation Society	20294	Marine mammal and sea turtle surveys to assess seasonal	Atlantic Ocean / Focal area: New York Bight and surrounding waters;	<u>Non-lethal</u>: A maximum of 350 green, 125 Kemp's ridley, 85 leatherback, 450 loggerhead, and 450 unidentified sea turtles. This project will conduct aerial	06/02/2017 to 06/01/2022

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
		abundance and distribution in the Mid-Atlantic region	Research can occur off MA,RI, CT, NY, NJ, DE, MD, VA, and NC	surveys, shipboard and land based surveys to assess seasonal abundance and distribution of threatened or endangered sea turtles in the Mid Atlantic waters.	
NMFS SEFSC	20339	Application for a scientific research and enhancement permit under the ESA; development and testing of gear aboard commercial fishing vessels	Atlantic Ocean, Gulf of Mexico, Caribbean Sea and tributaries (animals captured within fisheries managed by Federal authority)	Non-lethal: Under the TED Evaluations in Atlantic and Gulf of Mexico Trawl Fisheries study, a maximum of 220 (70 of these to include capture) loggerheads, 105 (25 of these captures) Kemp's ridleys, 85 (20 of these captures) leatherbacks, 50 (15 of these captures) greens, and 75 (25 of these captures) unidentified/hybrid turtles. Under the Evaluation of Longline Alternative Gear study, a maximum of 30 loggerheads, 10 Kemp's ridleys, 30 leatherbacks, 10 greens, and 10 unidentified/hybrid turtles. Animals will be handled, measured, weighed, photographed, flipper tagged, passive integrated transponder tagged, skin biopsied, and released. Lethal: Under the TED Evaluations in Atlantic and Gulf of Mexico Trawl Fisheries study, three loggerhead, two Kemp's ridley, two green, and one leatherback.	05/23/2017 to 05/31/2022
Virginia Aquarium & Marine Science Center	20561	2018 Renewal Request for Virginia Aquarium Sea Turtle Research Permit	Atlantic Ocean, Long Island Sound, Delaware Bay, Chesapeake Bay, North Carolina Sounds / Estuarine and ocean waters from shore to the continental shelf off of New York, New Jersey, Delaware, Maryland, Virginia and northern North Carolina including inshore brackish waters of bays, sounds and river mouths	Annual non-lethal take: Up to 90 turtles (30 green, 30 Kemp's ridley, 30 loggerhead) would be captured, sampled, and tagged. Up to one leatherback sea turtle may be opportunistically captured, sampled, and tagged.	08/24/2018 to 09/30/2027
NMFS SEFSC	21233	Demographic and life history studies of sea turtle populations in the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and tributaries	North Atlantic Ocean, Gulf of Mexico, Caribbean Sea including embayments and tributaries / Abundance, Health Demographic and Behavior Studies in	Annual non-lethal take: A maximum of 870 loggerheads, 665 greens, 575 Kemp's ridleys, 245 leatherbacks and 23 unidentified/hybrid hardshells. Lethal take: A maximum of two loggerheads, two Kemp's ridleys, two greens, and one leatherback, over the life of the permit. Numerous activities,	08/07/2018 to 09/30/2027

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
			the North Atlantic, Gulf of Mexico and Caribbean Sea – Beaufort and Miami Laboratory	including direct capture, sampling fisheries bycatch, biopsy collection, flipper tagging, and satellite tagging, are employed by the SEFSC throughout this region.	
NMFS NEFSC	22218	Northeast Fisheries Science Center Sea Turtle Ecology Program	US Locations including offshore waters	Annual non-lethal take: A maximum of 74 green, 90 Kemp's, 72 leatherback, and 115 loggerhead sea turtles, to harass 100 of each species (green, Kemp's, leatherback, loggerhead, plus unidentified), and to import or receive samples from 500 animals. Proposed take activities include harassing, capturing (by hand, dip net, cast net, hoop net, encircle net, seine net as well as by other authority), sampling, tagging, receiving samples, and import.	07/30/2019 to 09/30/2028

Table 18. Atlantic sturgeon section 10(a)(1)(A) permits within the action area.

Permittee	File #	Project	Area	Atlantic Sturgeon Takes	Research Timeframe
NMFS Headquarters	19642	Characterizing juvenile, sub-adult, and adult life stages of endangered Atlantic and Shortnose Sturgeon in the York, Rappahannock, Potomac, and Susquehanna Rivers, their tributaries, the Chesapeake Bay, and the Atlantic Coast	Atlantic Ocean and all tributaries to the ocean	Non-lethal: In the non-tributary study, a maximum of 200 Atlantic sturgeon would be tagged and sampled.	07/01/2016 to 06/30/2021
School of Marine and Atmospheric Sciences, Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in New York and Coastal Marine an Riverine Waters	Atlantic Ocean, Long Island Sound, Raritan Bay, Sandy Hook Bay, Delaware Bay / State and Federal marine and estuarine waters covering the continental shelf	Non-lethal: A maximum of 655 Atlantic sturgeon will be tagged and sampled. Lethal: Three Atlantic sturgeon	02/27/2016 to 03/31/2027
Delaware State University	20548	Reproduction, habitat use, and interbasin exchange of Atlantic and Shortnose Sturgeons in the mid-Atlantic	Nearshore Atlantic Ocean between Cape Charles, VA and Montauk, NY / Nearshore marine waters extending out to the 50 fathom line between Cape Charles, VA and Montauk, NY including coastal waters of VA, MD, DE, NJ, and NY	Non-lethal: A maximum of 1,701 Atlantic sturgeon will be tagged and sampled. Lethal: One Atlantic sturgeon	03/31/2017 to 03/31/2027

Section 10(a)(1)(B) Permits
Section 10(a)(1)(B) of the ESA authorizes NMFS, under some circumstances, to permit non-federal parties to take otherwise prohibited fish and wildlife if such taking is "incidental to, and not the purpose of carrying out otherwise lawful activities" (50 CFR 217-222). As a condition for issuance of a permit, the permit applicant must develop a conservation plan that minimizes negative impacts to the species.

Active permits and permit applications are posted online for all species as they become available at https://www.fisheries.noaa.gov/national/endangered-species-conservation/incidental-take-permits. Most coastal Atlantic states are either in the process of applying for permits or considering applications for state fisheries. We are actively working with several states and other parties on section 10(a)(1)(B) permits; however to date no section 10(a)(1)(B) permits have been authorized for New York state fisheries.

5.6 Contaminants, Pollution, and Water Quality
Excessive turbidity due to coastal development and/or construction sites could influence sea turtle and Atlantic sturgeon foraging ability; however, based on the best available information, turtle and Atlantic sturgeon foraging ability is not very easily affected by changes in increased suspended sediments unless these alterations make habitat less suitable for listed species and hinder their capability to forage and/or for their foraging items to exist. If the latter occurs, eventually these species will tend to leave or avoid these less desirable areas (Ruben and Morreale 1999). As the action area is entirely in saline waters, no early life stages of sturgeon species are expected to be in the action area. Thus, the effects to Atlantic sturgeon would only be limited to adults and subadults.

Marine debris (*e.g.*, discarded fishing line or lines from boats) can entangle turtles causing serious injuries or mortalities to these species. Turtles commonly ingest plastic or mistake debris for food (Magnuson *et al.* 1990). Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, industrial development, and debris. While the effects of contaminants on Atlantic sturgeon and turtles are relatively unclear, pollutants may make Atlantic sturgeon and sea turtles more susceptible to disease by weakening their immune systems or may have an effect on Atlantic sturgeon and sea turtle reproduction and survival.

The noise level in the ocean is thought to be increasing at a substantial rate due to increases in shipping and other activities, including seismic exploration, offshore drilling and sonar used by military and research vessels (Southall and Scholik-Schlomer 2007). Because under some conditions, low frequency sound travels very well through water, few oceans are free of the threat of human noise. Concerns about noise in the action area of this consultation include increasing noise due to increasing commercial shipping and recreational vessels. Although noise pollution has been identified as a concern for marine mammals, these elevated levels of underwater noise may also be of concern for sea turtles and Atlantic sturgeon. Until additional studies are undertaken, it is difficult to determine the effects these elevated levels of noise will have on sea turtles and Atlantic sturgeon and to what degree these levels of noise may be altering the behavior or physiology of these species.

As noted above, private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact sea turtles and Atlantic sturgeon. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. It is important to note that minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so it is more likely to become vulnerable to effects such as entanglements. Listed species may also be affected by fuel oil spills resulting from vessel accidents. Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species.

5.7 State or Private Activities in the Action Area

5.7.1 Private and Commercial Vessel Operations

The New York/New Jersey Harbor complex is a major shipping port and center of commerce, there are numerous private and commercial vessels (*e.g.*, container ships, commuter ferries) that operate in the action area that have the potential to interact with listed species. On an annual basis more than 5,124 commercial vessels and approximately 5,292,020 container vessels, as well as numerous recreational vessels transit the New York Harbor complex.

Data shows that vessel traffic is a substantial cause of sea turtle mortality. Fifty to 500 loggerheads and five to 50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC 1990). The report indicates that this estimate is highly uncertain and could be a large overestimate or underestimate. As described in the Recovery Plan for loggerhead sea turtles (NMFS and USFWS 2008), propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9 percent of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. As noted from the National Research Council (1990), the regions of greatest concern for vessel strike are outside the action area and include areas with high concentrations of recreational-boat traffic such as the eastern Florida coast, the Florida Keys, and the shallow coastal bays in the Gulf of Mexico. In general, the risk of strike for sea turtles is considered to be greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels or speed boats (NRC 1990).

In certain geographic areas, vessel strikes have been identified as a threat to Atlantic sturgeon. Although the exact number of Atlantic sturgeon killed as a result of being stuck by vessels is unknown, records of these interactions have been documented (Balazik 2018, Balazik *et al.* 2012c, Brown and Murphy 2010). Other commercial and private activities therefore, have the potential to result in lethal (boat strike) or non-lethal (through harassment) takes of listed species that could prevent or slow a species' recovery. As sea turtles and Atlantic sturgeon may be in the area where high vessel traffic occurs, the potential exists for collisions with vessels transiting from within and out of the action area.

An unknown number of private recreational boaters frequent coastal waters; some of these are engaged in whale watching or sport fishing activities. These activities have the potential to result in lethal (through entanglement or boat strike) or non-lethal (through harassment) takes of listed species. Effects of harassment or disturbance which may be caused by such vessel activities are currently unknown; however, no conclusive detrimental effects have been demonstrated.

5.7.2 State-run Facilities

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contaminants may also have an effect on sea turtle reproduction and survival. Dredging and point source discharges (*i.e.*, municipal wastewater, industrial or power plant cooling water or waste water) and compounds associated with discharges or released from the sediments during dredging operations (*i.e.*, metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH or dissolved oxygen levels of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival. Pollution may make sea turtles more susceptible to disease by weakening their immune systems.

5.7.3 Non-Federally Regulated Fishery Operations

State fisheries do operate in the state waters of New York. Very little is known about the level of interactions with listed species in fisheries that operate strictly in state waters. Impacts on sea turtles and Atlantic sturgeon from state fisheries may be greater than those from federal activities in certain areas due to the distribution of these species in these waters. Depending on the fishery in question, however, many state permit holders also hold federal licenses; therefore, section 7 consultations on federal actions in those fisheries address some state-water activity. NMFS is actively participating in a cooperative effort with the ASMFC and member states to standardize and/or implement programs to collect information on level of effort and bycatch of protected species in state fisheries. When this information becomes available, it can be used to refine take reduction plan measures in state waters.

5.8 Conservation and Recovery Actions Reducing Threats to Listed Species

A number of activities are in progress that may ameliorate some of the threat that activities summarized in the *Environmental Baseline* pose to threatened and endangered species in the action area of this consultation. These include recovery planning, education/outreach activities, and the salvage program.

5.8.1 Reducing Threats to Listed Sea Turtles

NMFS has implemented multiple measures to reduce the capture and mortality of sea turtles in fishing gear, and other measures to contribute to the recovery of these species.

Education and Outreach Activities

Education and outreach activities are considered one of the primary tools to reduce the threats to all protected species. For example, NMFS has been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques, as well as guidelines for recreational fishermen and boaters to avoid the likelihood of interactions with marine mammals. NMFS intends to continue these outreach efforts in an attempt to reduce interactions with protected species, and to reduce the likelihood of injury to protected species when interactions do occur.

Sea Turtle Stranding and Salvage Network (STSSN)
The Sea Turtle Stranding and Salvage Network (STSSN) does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles, reducing mortality of injured or sick animals. NMFS manages the activities of the STSSN. Data collected by the STSSN are used to monitor stranding levels, to identify areas where unusual or elevated mortality is occurring, and to identify sources of mortality. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help improve our understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

Sea Turtle Disentanglement Network (STDN)
The Sea Turtle Disentanglement Network (STDN) is considered a component of the larger STSSN program, and it operates in all states in the region. The STDN responds to entangled sea turtles and disentangles and releases live animals, thereby reducing serious injury and mortality. In addition, the STDN collects data on live and dead sea turtle entanglement events, providing valuable information for management purposes. The NMFS GARFO oversees the STDN program and manages the STDN database.

Atlantic Sturgeon Recovery Planning
Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing. We will be convening a recovery team and drafting a recovery plan to outline recovery goals and criteria, as well as steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway involving NMFS and other federal, state, and academic partners to obtain more information on the distribution and abundance of Atlantic sturgeon throughout their range, including in the action area, and to develop population estimates for each DPS. Efforts are also underway to better understand threats faced by the DPSs and to find ways to minimize these threats, including bycatch, vessel strikes, and water quality. Fishing gear researchers are working on designing fishing gear that minimizes interactions with Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA Section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on Atlantic sturgeon.

Education and Outreach Activities
NMFS has a program called "SCUTES" (Student Collaborating to Undertake Tracking Efforts for Sturgeon), which offers educational programs and activities about the movements, behaviors, and threats to Atlantic sturgeon. NMFS intends to continue these outreach efforts in an attempt to reduce interactions with protected species, and to reduce the likelihood of injury to protected species when interactions do occur.

Sturgeon Salvage Program
A salvage program is now in place for Atlantic sturgeon. Atlantic sturgeon carcasses can provide pertinent life history data and information on new or evolving threats to Atlantic sturgeon. Their use in scientific research studies can reduce the need to collect live Atlantic sturgeon. The NMFS Sturgeon Salvage Program is a network of individuals qualified to retrieve and/or use Atlantic and shortnose sturgeon carcasses and parts for scientific research and education. All carcasses and parts are retrieved opportunistically and participation in the network is voluntary.

5.9 Status of Sea Turtles in the Action Area

Sea turtles are seasonally present in New York waters from May to mid November each year, with the highest number of individuals present from June to October. One of the main factors influencing sea turtle presence in northern waters is seasonal temperature patterns (Ruben and Morreale 1999). Temperature is correlated with the time of year, with the warmer waters in the late spring, summer, and early fall being the most suitable for cold-blooded sea turtles. Sea turtles are most likely to occur in the action area between June and October when water temperatures are above 11°C and depending on seasonal weather patterns, could be present in May and early November. Sea turtles have been documented in the action area by surveys conducted by NMFS Northeast Science Center and fisheries observers.

Satellite tracking studies of sea turtles in the Northeast found that foraging turtles mainly occurred in areas where the water depth was between approximately 16 and 49 feet (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1994). The areas to be dredged and trawled (approximately 23 to 78 feet (Tetra Tech 2019)) and the depths preferred by sea turtles overlap, suggesting that if suitable forage is present, adult and juvenile loggerheads, juvenile Kemp's ridleys, and juvenile green sea turtles may forage in the channel areas where dredging will occur. As there are no SAV beds in any of the channel areas where dredging will take place, primarily herbivorous adult green sea turtles are not likely to use the areas to be dredged as forage habitat.

5.10 Status of Atlantic Sturgeon in the Action Area

The marine and estuarine range of all five Atlantic sturgeon DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Based on the best available information, Atlantic sturgeon originating from any of five DPSs could occur in the waters of the action area. The proposed activities do not overlap with freshwater riverine habitat; therefore, spawning, eggs, and early life stages will not occur in the action area. Subadult, and adult Atlantic sturgeon are likely to occur in nearshore waters of the action area as they have been documented in coastal ocean waters off of New York year-round. Adult and subadult Atlantic sturgeon from any of the five DPSs are known to use the action area for spawning migration and to opportunistically forage. Migratory behaviors occur from April to November (Dovel and Berggren 1983, Welsh *et al.* 2002). Both adults and subadults are expected to wander among coastal and estuarine habitats of the bay. Foraging behaviors typically occur in areas where suitable forage and appropriate habitat conditions are present. These areas include tidally influenced flats and mud, sand, and mixed cobble substrates (Stein *et al.* 2004b).

There is an Atlantic sturgeon aggregation off the coast of Long Island (Figure 24). Atlantic sturgeon aggregations are generally restricted to shallow depths (<20 m) in New York waters, following a seasonal pattern with peak abundance during the spring and fall (Dunton *et al.* 2015). In a study by Dunton *et al.* (2015), catches of Atlantic sturgeon were an order of magnitude higher than in other areas and months of the year during the peak aggregation months of May, June, September, and October.

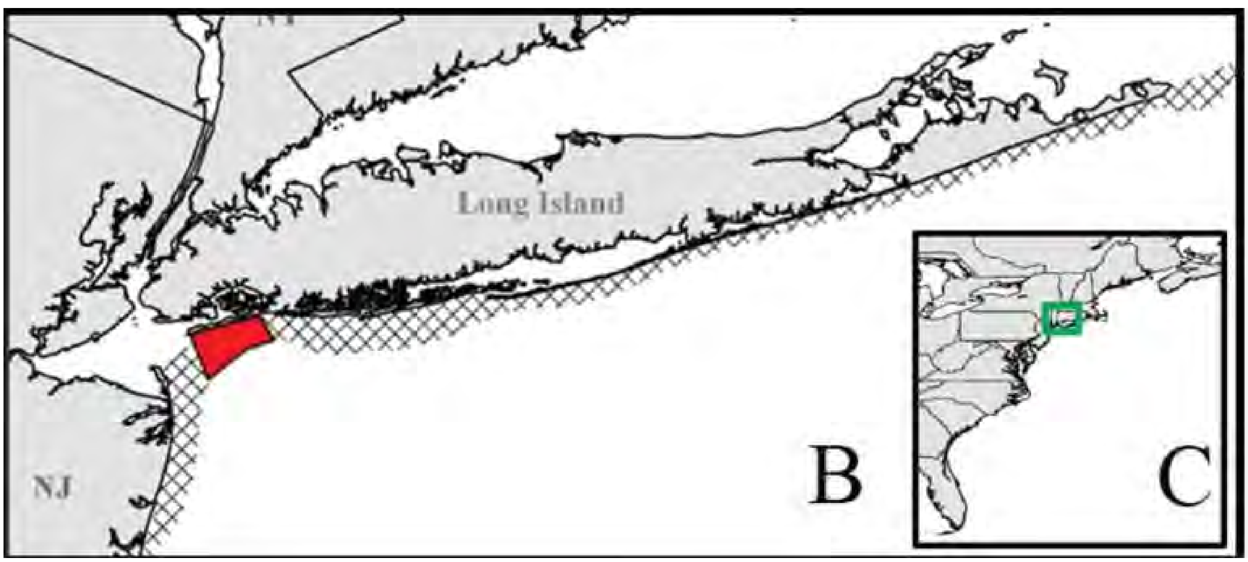

Figure 24. Atlantic sturgeon aggregation area (red area) and their migration corridors (hatched) (Dunton et al. 2015).

Erickson *et al.* (2011) and Breece *et al.* (2016) also provide new information that better informs the seasonal migratory movements of the New York Bight DPS, and their use of aggregation areas. The new information supports the notion that Atlantic sturgeon move into deeper waters in the fall compared to the depth where they occur in the spring in marine habitat. We knew when we listed the DPS that, in general, there is a northerly coastal migration of subadult and adult Atlantic sturgeon into estuaries in the spring, and a southerly coastal migration from estuaries in the fall. Some marine aggregation areas were suspected of functioning as overwintering areas, such as in waters off of the Virginia and North Carolina coast. However, the adult sturgeon tagged by Erickson *et al.* (2011) left the Hudson River from early July to early October. The data did not suggest movement from the river to a specific marine area where the fish reside throughout the winter. Instead, the sturgeon occurred within different areas of the

Mid-Atlantic Bight and at different depths, occupying deeper and more southern waters in the winter months and more northern and shallow waters in the summer months with spring and fall acting as a transition period. The model constructed by Breece *et al.* (2016) similarly predicts an increase in probability of occurrence in shallow water during the spring, which shifts to an increase in probability of occurrence in deeper water in the fall. Further evidence of these seasonal nearshore and offshore movements was provided by Ingram *et al.* (2019). Their study monitored detections of acoustically-tagged Atlantic sturgeon in the New York Wind Energy Area (NY WEA), an offshore wind-lease area located between Long Island and the coast of New Jersey that extends 11.5 to 24 nautical miles southeast of Long Island, New York with water depths ranging from 23 to 41 m (Figure 25). Like the more geographically broad studies of Erickson et al., and Breece et al., the results demonstrated that the acoustically-tagged sturgeon were most abundant in the offshore NY WEA in the winter months (*i.e.*, December through February) and least abundant, including zero detections in some years, during the months of July through September Ingram *et al.* (2019). The sturgeon occurred throughout the NY WEA in the winter months, including the waters furthest from shore and up to 41 m deep.

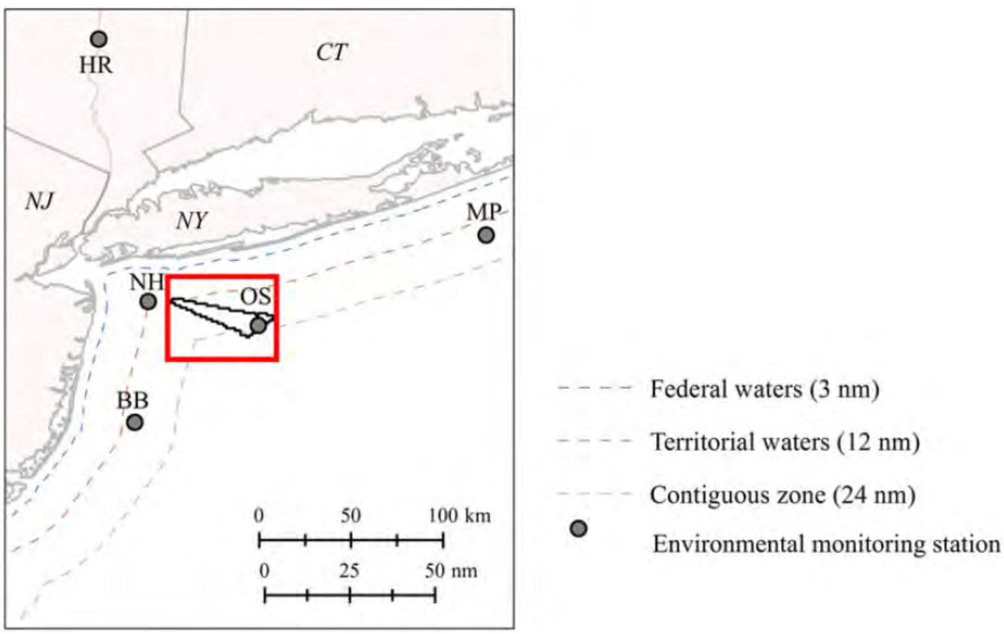

Figure 25. Map of the New York Wind Energy study site and the relative location in federal waters of the Atlantic Ocean off the coast of New York and New Jersey (Ingram et al. 2019).

6 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change on listed species in the action area over the lifespan of the proposed project (*i.e.*, 2020-2039). Climate change is relevant to the Status of the Species, Environmental Baseline, and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion, below.

6.1 Background Information on Global Climate Change

In its Fifth Assessment Report (AR5) from 2014, the Intergovernmental Panel on Climate Change (IPCC) stated that the globally averaged combined land and ocean surface temperature data has shown a warming of 0.85°C (likely range: 0.65° to 1.06°C) over the period of 1880-2012 (IPCC 2014). Similarly, the total increase between the average of the 1850-1900 period and the 2003-2012 period is 0.78°C (likely range: 0.72° to 0.85°C). On a global scale, ocean warming has been largest near the surface, with the upper 75 meters of the world's oceans having warmed by 0.11°C (likely range: 0.09° to 0.13°C) per decade over the period of 1971-2010 (IPCC 2014). In regards to resultant sea level rise, it is very likely that the mean rate of global averaged sea level rise was 1.7 millimeters/year (likely range: 1.5 to 1.9 millimeters/year) between 1901 and 2010, 2.0 millimeters/year (likely range: 1.7 to 2.3 millimeters/year) between 1971 and 2010, and 3.2 millimeters/year (likely range: 2.8 to 3.6 millimeters/year) between 1993 and 2010.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next several decades. The global mean surface temperature change for the period 2016-2035 relative to 1986-2005 will likely be in the range of 0.3° to 0.7°C (medium confidence). This assessment is based on multiple lines of evidence and assumes there will be no major volcanic eruptions or secular changes in total solar irradiance. Relative to natural internal variability, near-term increases in seasonal mean and annual mean temperatures are expected to be larger in the tropics and subtropics than in mid- and high latitudes (high confidence). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has also resulted in increased river discharge and glacial and sea-ice melting (Greene *et al.* 2008). The strongest ocean warming is projected for the surface in tropical and Northern Hemisphere subtropical regions. At greater depths, the warming will be most pronounced in the Southern Ocean (high confidence). Best estimates of ocean warming in the top 100 meters are about 0.6° to 2.0°C, and about 0.3° to 0.6°C at a depth of about 1,000 meters by the end of the 21st century (IPCC 2014).

Under Representative Concentration Pathway (RCP) 8.5, the projected change in global mean surface air temperature and global mean sea level rise for the mid- and late 21st century relative to the reference period of 1986-2005 is as follows. Global average surface temperatures are likely to be 2.0°C higher (likely range: 1.4° to 2.6°C) from 2046-2065 and 3.7°C higher (likely range: 2.6° to 4.8°C) from 2081-2100. Global mean sea levels are likely to be 0.30 m higher (likely range: 0.22 to 0.38 m) from 2046-2065 and 0.63 m higher (likely range: 0.45 to 0.82 m) from 2081-2100, with a rate of sea level rise during 2081-2100 of eight to 16 millimeters/year (medium confidence).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (IPCC Greene *et al.* 2008, 2007). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC 2007). The NAO impacts climate variability throughout the Northern Hemisphere (IPCC 2007). Data from the 1960s through the 2000s showed that the NAO index increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2007). Strong positive phases of the NAO tend to be associated with above-normal temperatures in the eastern United States and across northern Europe and below-normal temperatures in Greenland and oftentimes across southern Europe and the Middle East. They are also associated with above-normal precipitation over northern Europe and Scandinavia and below-normal precipitation over southern and central Europe. Opposite patterns of temperature and precipitation anomalies are typically observed during strong negative phases of the NAO. This warming extends over 1,000 m deep and is deeper than anywhere in the world's oceans and is particularly evident under the Gulf Stream/North Atlantic Current system (IPCC 2007). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (IPCC Greene *et al.* 2008, 2007). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the entire world (Greene *et al.* 2008).

There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007). These trends have been most apparent over the past few decades, although this may also be due to increased research. Information on future impacts of climate change in the action area is discussed below. While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the action area, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Additional information on potential effects of climate change specific to the action area is discussed below. Warming is very likely to continue in the U.S. over the next 50 years regardless of reduction in greenhouse gases, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 50 years, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

Expected consequences of climate change for river systems could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources along the U.S. Atlantic coast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers. Consequently, these rivers will have larger areas that need reactive or proactive management interventions in response to climate change (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2°C per decade; and 3) a rise in sea level (NAST 2000). Sea level is expected to continue rising; during the 20th century global sea level has increased 15 to 20 centimeters. It is also important to note that ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average and thus existing projections from the IPCC may be too conservative (Saba *et al.* 2015).

6.2 Anticipated Effects of Climate Change in the Action Area to Sea Turtles

Sea turtle species have persisted for millions of years and throughout this time have experienced wide variations in global climate conditions and have successfully adapted to these changes. As such, climate change at normal rates (thousands of years) is not thought to have historically been a problem for sea turtle species. Sea turtles are most likely to be affected by climate change due to (1) changing air temperature and rainfall at nesting beaches, which in turn could impact nest success (hatching success and hatchling emergence rate) and sex ratios among hatchlings; (2) sea level rise, which could result in a reduction or shift in available nesting beach habitat and increased risk of nest inundation; (3) changes in the abundance and distribution of forage species, which could result in changes in the foraging behavior and distribution of sea turtle species; and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing of nesting seasons, timing of migrations). Over the time period of this action considered in this Opinion, sea surface temperatures are expected to rise less than 2°C. It is unknown if that is enough of a change to contribute to shifts in the range, distribution, and recruitment of sea turtles. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present or sea turtles could be present for longer periods of time.

It has been speculated that the nesting range of some sea turtle species may shift northward. Nesting in the Mid-Atlantic generally is extremely rare and no nesting has been documented at any beach in the Northeast. In 2010, one green sea turtle came up on the beach in Sea Isle City, New Jersey; however, it did not lay any eggs. In August 2011, a loggerhead came up on the beach in Stone Harbor, New Jersey, but did not lay any eggs. On August 18, 2011, a green sea turtle laid one nest at Cape Henlopen Beach in Lewes, Delaware, near the entrance to Delaware Bay. The nest contained 190 eggs and was transported indoors to an incubation facility on October 7. A total of 12 eggs hatched, with eight hatchlings surviving. In December, seven of the hatchlings were released in Cape Hatteras, North Carolina. In September 2017, about 100 baby loggerheads successfully emerged from nests on the Maryland side of Assateague Island. For the first time on July 2018, a Kemp's ridley sea turtle was spotted depositing her eggs on the western part of the Rockaway Peninsula in Queens, New York. In September 2018, the nest started to flood from high tides and a storm system, so the National Park Service received permission from the U.S. Fish and Wildlife Service to dig up the nest and incubate the eggs at a park facility. Later that month, 96 of the 116 eggs hatched. The turtles were later released on the beach where they were found. It is important to consider that in order for nesting to be successful in the Mid-Atlantic, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings not to die when they enter the water. The projected increase in ocean temperature over the next fifty years is unlikely to allow for successful rearing of sea turtle eggs in the action area. However, if increased nesting activity were to begin occurring, that would constitute new information that may require reinitiation of this Opinion.

6.3 Anticipated Effects of Climate Change in the Action Area to Atlantic Sturgeon

Information on how climate change will impact the action area is extremely limited. According to the New York State Energy Research and Development Authority's 2011 ClimAID Synthesis Report, temperatures across New York State are expected to rise by 1.5 to 3°F by the 2020s, 3.0 to 5.5°F by the 2050s, and 4 to 9°F by the 2080s (ClimAID 2011). In 2014, ClimAID updated their projections saying that temperature is expected to increase by 2.0 to 3.4°F by the 2020s, 4.1 to 6.8°F by the 2050s, and 5.3 to 10.1°F by the 2080s. The IPCC models predict that precipitation will continue to increase across the Northeast by 5 to 10% by 2050, although the distribution of this increase is likely to vary across the climate zones. The latest predictions from ClimAID (2014) say that precipitation in New York State is projected to increase by approximately one to eight percent by the 2020s, three to 12 percent by the 2050s, and four to 15 percent by the 2080s. They also add that sea level rise could potentially increase by three to eight inches by the 2020s, nine to 21 inches by the 2050s, and 14 to 39 inches by the 2080s (ClimAID 2014). As sea levels rise, coastal flooding associated with storms will very likely increase in intensity, frequency, and duration, which means that flooding at the level currently associated with the 100-year flood may occur about 19 times as often by the end of the century (ClimAID 2014).

Sea surface temperatures have fluctuated around a mean for much of the past century, as measured by continuous 100+ year records at Woods Hole (Mass.), and Boothbay Harbor (Maine) and shorter records from Boston Harbor and other bays. Periods of higher than average temperatures (in the 1950s) and cooler periods (1960s) have been associated with changes in the North Atlantic Oscillation (NAO), which affects current patterns. Over the past 30 years however, records indicate that ocean temperatures in the Northeast have been increasing; for example, since 2004, sea surface temperatures in the Gulf of Maine have accelerated to 0.41°F (0.23 °C) per year; a rate that is faster than 99% of the world's oceans (Fernandez *et al.* 2015). While we are not able to find predictive models for New York, given the geographic proximity of these waters to the Northeast, we assume that predictions would be similar. Assuming that these predictions also apply to the action area, one could anticipate similar conditions in the action area.

Assuming that there is a linear trend in increasing water temperatures, and that a predicted 0.41°F increase in water temperature per year for the waters to the Northeast would also be experienced in the action area, we expect an increase in temperature of up to 12.3°F in the action area over the duration of the proposed action (30 years).

Global climate change may affect all DPSs of Atlantic sturgeon in the future; however, effects of increased water temperature and decreased water availability are most likely to affect the South Atlantic and Carolina DPSs. Water availability, either too much or too little, as a result of global climate change is expected to have an effect on the features essential to successful sturgeon spawning and recruitment of the offspring to the marine environment (for Atlantic sturgeon). The increased rainfall predicted by some models in some areas may increase runoff, scour spawning areas, and create flooding events that dislodge early life stages from the substrate where they refuge in the first weeks of life. High freshwater inputs during juvenile development can influence juveniles to move further downriver and, conversely, lower than normal freshwater inputs can influence juveniles to move further upriver potentially exposing the fish to threats they would not typically encounter. Increased number or duration of drought events (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spawning season(s) may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all sturgeon life stages, including adults, may become susceptible to stranding or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues including effects to the combined interactions of dissolved oxygen, water temperature, and salinity. Elevated air temperatures can also impact dissolved oxygen levels in the water, particularly in areas of low water depth, low flow, and elevated water temperature. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems affecting dissolved oxygen and temperature.

The action area encompasses the saline Atlantic Ocean. The relatively short timeframe of the proposed action (2020-2039) makes any prediction of large scale and long-term climate change effects difficult. That said, over the next 19 years, we do not expect the salinity of the action area to change in any way that would meaningfully alter the use of the habitat for sturgeon foraging, migration, or resting.

Over time, the most likely effect to Atlantic sturgeon would be if sea level rise was great enough to consistently shift the salt wedge far enough north in a spawning river which would restrict the range of juvenile sturgeon and may affect the development of these life stages. However, there are no spawning rivers in the action area.

In the action area, it is possible that changing seasonal temperature regimes could result in shifts in the timing of seasonal migrations through the area as sturgeon move throughout the area. Atlantic sturgeon tolerate water temperatures up to approximately 28°C (82.4 °F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, Atlantic sturgeon may be excluded from some habitats. Additionally, temperature cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey.

Spawning behaviors are not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change). It is difficult to predict how any change in water temperature or river flow will affect the seasonal movements of sturgeon through the action area. However, it seems most likely that spawning would shift to earlier in the year.

Any forage species that are temperature dependent may also shift in distribution as water temperatures warm. However, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening is low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

Limited information on the thermal tolerances of Atlantic sturgeon is available. Atlantic sturgeon have been observed in water temperatures above 30°C in the south (Damon-Randall *et* *al.* 2010). In the laboratory, juvenile Atlantic sturgeon in freshwater showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Jenkins *et al.* 1993, Ziegeweid *et al.* 2008), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Rising temperatures could meet or exceed the tolerated temperature of Atlantic sturgeon (28°C) on more days and/or in larger areas. This could result in shifts in the distribution of sturgeon out of certain areas during the warmer months. Information from southern river systems suggests that during peak summer heat, sturgeon are most likely to be found in deep water areas where temperatures are coolest. Thus, we could expect that over time, sturgeon would shift out of shallow habitats on the warmest days. This could result in reduced foraging opportunities if sturgeon were foraging in shallow waters.

Mean monthly ambient temperatures at Montauk, New York, range from 35-70°F[6]. As explained above, available predictions estimate an increase in ambient water temperature in the area of up to 12.3°F over the duration of the proposed action. This would result in the ambient sea temperatures in New York, to range from 8.5–27.9°C. Warming temperatures predicted to occur over the next 50 years would likely result in a northward shift/extension of their range (*i.e.*, into the St. Lawrence River, Canada) while truncating the southern distribution, thus effecting the recruitment and distribution of sturgeon rangewide. However, Atlantic sturgeon are known to currently occur at temperatures consistent with the predicted range over the next 30 years (up to 82.4°F). If any shift does occur, it seems unlikely that this small increase in temperature will cause any significant effects to Atlantic sturgeon or a significant modification to the number of sturgeon likely to be present in the action area over the life of the action.

As described above, over the long term, global climate change may affect Atlantic sturgeon by affecting the location of the salt wedge, distribution of prey, water temperature and water quality. However, there is significant uncertainty, due to a lack of scientific data, on the degree to which these effects may be experienced and the degree to which Atlantic sturgeon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to global climate change are also expected to affect Atlantic sturgeon in the action area. While we can make some predictions on the likely effects of climate change on these species, without modeling and additional scientific data these predictions remain speculative. Additionally, these predictions do not take into account the adaptive capacity of these species which may allow them to deal with change differently than predicted.

7 EFFECTS OF THE ACTION

This section of an Opinion assesses all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (Sec § 402.17). Because there is no critical habitat in the action area, there are no

[6] Information obtained from www.nodc.noaa.gov/dsdt/cwtg/satl.html; last accessed 2-7-2020.

consequences to critical habitat to consider in this Opinion.

This Opinion examines the likely consequences of the proposed action on the four species of sea turtles and the five DPSs of Atlantic sturgeon in the action area and their habitat. We consider these consequences on the species and their habitat within the context of the species status now and projected over the course of the action, the environmental baseline, and cumulative effects.

As explained in the "Description of the Proposed Action" section (3.0), the action under consideration in this Opinion includes the initial and renourishment dredging cycles needed to aquire sand for four beach nourishment projects (*i.e.*, LB, FIMI, ER, and FIMP), the proposed action the USACE may undertake for shore protection and flood risk management (*i.e.*, placement of fill, pile driving, groins), and conducting biological analyses of aquatic resources at the NYOBAs by utilizing trawling gear in order to comply with NYSDEC's aquatic biological monitoring mandates. We also consider consequences of these projects through 2039. We have divided the following sections by the project related stressors we have identified that may have an effect on listed species.

7.1 Sedimentation and Turbidity

7.1.1 Hopper Dredge

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column, as distance increases from the dredge operations. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (*i.e.*, waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. Use of this "overflow" technique results in a larger sediment plume than if no overflow is used. In 1998, a study was done of overflow and nonoverflow hopper dredging using the McFarland hopper dredge (USACE 2013). Monitoring of the sediment plumes was accomplished using a boat-mounted 1,200-kHz Broad-Band Acoustic Doppler Current Profiler (ADCP). The instrument collects velocity vectors in the water column together with backscatter levels to determine the position and relative intensity of the sediment plume. Along with the ADCP, a MicroLite recording instrument with an Optical

Backscatterance (OBS) Sensor was towed by the vessel at a depth of 15 feet. The MicroLite recorded data at 0.5-sec intervals. Navigation data for monitoring were obtained by a Starlink differential Global Positioning System (GPS). The GPS monitors the boat position from the starting and ending points along each transect.

Transects were monitored in the test area to obtain the background levels of suspended materials prior to dredging activities. A period of eight minutes following the dredge passing during non-overflow dredging showed the level of suspended material to be returning to background levels. No lateral dispersion of the plume out of the channel was observed during the non-overflow dredging operation. During overflow dredging, a wider transect was performed to determine the lateral extent of the plume. At one-hour elapsed time following the end of the overflow dredging operation, the levels of suspended material returned to background conditions. Again, no lateral dispersion of the plume out of the Delaware River was observed. Overflow dredging is not proposed during dredging operations.

Near-bottom plumes caused by hopper dredges may extend approximately 2,300 to 2,400 feet (701-731 meters) downcurrent from the dredge (USACE 1983). TSS concentrations may be as high as several hundred mg/L near the discharge port and as high as several tens of mg/L near the draghead. In a literature review conducted by Anchor Environmental (2003), near-field concentrations ranged from 80.0-475.0 mg/L. TSS and turbidity levels in the near-surface plume usually decrease exponentially with increasing time and distance from the active dredge due to settling and dispersion, quickly reaching ambient concentrations and turbidities. In almost all cases, the majority of re-suspended sediments resettle close to the dredge within one hour, although very fine particles may settle during slack tides only to be re-suspended by ensuing peak ebb or flood currents (Anchor Environmental 2003).

7.1.2 Cutterhead Dredge

Cutterhead dredges use suction to entrain sediment for pumping through a pipeline to a designated discharge site. Production rates vary greatly based on pump capacities and the type (size and rotational speed) of cutter used, as well as distance between the cutterhead and the substrate. Sediments are re-suspended during lateral swinging of the cutterhead as the dredge progresses forward. Modeling results of cutterhead dredging indicated that TSS concentrations above background levels would be present throughout the bottom six feet (1.8 meters) of the water column for a distance of approximately 1,000 feet (305 meters) (USACE 1983). Elevated suspended sediment levels are expected to be present only within a 984.3 to 1,640.4 foot (300-500 meters) radius of the cutterhead dredge (USACE Hayes *et al.* 2000, LaSalle 1990, 1983, Wilber and Clarke 2001). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad 2001, USACE 2015).

7.1.3 Beach Nourishment and Fill

The placement of dredged material along beaches or shorelines will cause an increase in localized turbidity in the nearshore environment. Nearshore turbidity impacts from fill

No information is available on the effects of TSS on juvenile and adult sea turtles. TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. Sea turtles may be exposed to effects of TSS or other water quality factors through the uptake of water when they feed. Even if sea turtles ingested the transient plumes, it would be brief and low in frequency. In all cases where sea turtles would be exposed to increased TSS resulting from proposed activities in this Opinion (mainly the Atlantic Ocean), the area is sufficiently wide for the highly mobile sea turtles to avoid any sediment plume with minor movements. The movements will be so small that it will not require use of energy beyond what they would use without the avoidance. They are also not nesting, therefore, the plume will not hinder access to nesting beaches and will, therefore, not result in major movements to find new beaches. As sea turtles breathe air and are highly mobile, they are likely to be able to avoid any sediment plume and any effect on their movements will be insignificant. While the increase in suspended sediments may cause sea turtles to alter their normal movements, any change in behavior will only involve minor movements to alter their course away from the sediment plume which will not disrupt any essential life behaviors. Based on this information, we believe the effects of suspended sediment on sea turtles resulting from increased turbidity are too small to be meaningfully measured or detected and are insignificant.

Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The TSS levels expected for all of the proposed activities (ranging from <5 mg/L to 550.0 mg/L) are below those shown to have adverse effects on fish (typically up to 1,000 mg/L) (Burton 1993). We expect sturgeon to either swim through the plumes associated with the project, or make small evasive movements to avoid them. Based on the best available information as presented above, we will not be able to meaningfully detect, evaluate, or measure the effects of re-suspended sediment on sturgeon when added to baseline conditions. Therefore, effects on sturgeon are insignificant.

7.2 Noise from the Installation of Piles

The plan for ER along the Jamaica Bay/Back Bay (JB/BB) component of the project is a combination of High Frequency Flood Risk Reduction Features (HFFRRF) features such as bulkheads and floodwalls, and natural and nature-based non-structural features (NNBFs). The bulkheads will be made of steel sheet piles. The method of pile driving is not settled yet, but would likely be accomplished by either vibration hammering or a low key speed vibratory drilling process. To be conservative, we will analyze the effects of noise from using an impact hammer, in case it is used.

7.2.1 Criteria for Assessing the Potential for Physiological Effects to Sturgeon

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, U.S. FWS, FHWA, and the California, Washington, and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a Memorandum of Agreement documenting criteria for assessing physiological effects of pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted that these are onset of physiological effects (Stadler and Woodbury 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μPa).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1μPa^2-s) for fishes above 2 grams (0.07 ounces).
- cSEL: 183 dB re 1μPa^2-s for fishes below 2 grams (0.07 ounces).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to sturgeon from exposure to impulsive noise, such as pile driving, are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness, to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer the fish is to the source, and the greater the duration of the exposure, the higher likelihood of significant injury.

Since the FHWG criteria were published, two papers relevant to assessing the effects of pile driving noise on fish have been published. Halvorsen *et al.* (2011) documented effects of pile driving sounds (recorded by actual pile driving operations) under simulated free-field acoustic conditions where fish could be exposed to signals that were precisely controlled in terms of number of strikes, strike intensity, and other parameters. The study used Chinook salmon and determined that onset of physiological effects that have the potential of reduced fitness, and thus a potential effect on survival, started at above 210 dB re 1μPa^2-s cSEL. Smaller injuries, such as ruptured capillaries near the fins, which the authors noted were not expected to impact fitness, occurred at lower noise levels.

Halvorsen *et al.* (2012a) exposed lake sturgeon to pile driving noise in a laboratory setting. Lake sturgeon used in this experiment were three to four months old and were approximately 60-70 mm in length and weighed 1.2 -2.0 grams (n=141). Tested fish were exposed to five treatments of 960 pile strikes with cSEL ranging from 216 dB re 1μPa^2-s to 204 dB re 1μPa^2-s. Following testing, fish were euthanized and examined for external and internal signs of barotrauma. None of the lake sturgeon died as a result of noise exposure. Lake sturgeon exhibited no external injuries in any of the treatments but internal examination revealed injuries consisting of hematomas on the swim bladder, kidney, and intestines (characterized by the authors as "moderate" injuries) and partially deflated swim bladders (characterized by the authors as "minor" injuries). Injuries were only observed in lake sturgeon exposed to cSEL greater than 210 dB re 1μPa^2-s. All sturgeon were exposed to all 960 pile strikes and only cumulative sound exposure was tested during this study. No behavioral responses are reported in the paper. Results from Halvorsen *et al.* (2012b) suggest that the overall response to noise between chinook salmon and lake sturgeon is similar (sturgeon and salmon are hearing generalists with physostomous swim bladders).

It is important to note that Halvorsen *et al.* (2012a), (2012b) both used a response weighted index (RWI) to categorize injuries as mild, moderate, or mortal. Mild injuries (RWI 1) were determined by the authors to be non-life threatening. The authors made their recommendations for noise exposure thresholds at the RWI 2 level and used the mean RWI level for different exposures. We consider even mild injuries to be physiological effects and we are concerned about the potential starting point for physiological effects and not the mean. Therefore, for the purposes of carrying out section 7 consultations, we will use the FHWG criteria to assess the potential physiological effects of noise on Atlantic sturgeon and not the criteria recommended by Halvorsen *et al.* (2012a), (2012b). Following the FHWG criteria, we will consider the potential for physiological effects upon exposure to impulsive noise of 206 dB re 1μPa^2-s Peak. Use of the 187 dB re 1μPa^2-s cSEL is a cumulative measure of cumulative impulsive sound (such as impact pile driving). As explained here, physiological effects from noise exposure can range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality or result in death. The injury thresholds for sea turtles are not expected to be met (Table 21).

7.2.2 Criteria for Assessing the Potential for Behavioral Effects to Sea Turtles and Sturgeon

Currently, there are no NMFS established criteria for behavioral disturbance or harassment for sea turtles. As described above, the hearing capabilities of sea turtles are poorly known and there is little available information on the effects of noise on sea turtles. Some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals and must be interpreted cautiously. Most recently, McCauley *et al.* (2000) noted that decibel levels above 175 dB re 1μPaRMS elicited avoidance behavior of sea turtles. The study done by McCauley *et al.* (2000), as well as other studies done to date, used impulsive sources of noise (*e.g.*, air gun arrays) to ascertain the underwater noise levels that produce behavioral modifications in sea turtles. As no other studies have been done to assess the effects of impulsive and continuous noise sources on sea turtles, McCauley *et al.* (2000) serves as the best available information on the levels of underwater noise that may produce a startle, avoidance, and/or other behavioral or physiological response in sea turtles. Based on this and the best available information, NMFS believes any sea turtles exposed to underwater noise greater than 175 dBRMS may experience behavioral disturbance/modification (*e.g.*, movements away from ensonified area).

Results of empirical studies of hearing of fishes, amphibians, birds, and mammals (including humans), in general, show that behavioral responses vary substantially, even within a single species, depending on a wide range of factors, such as the motivation of an animal at a particular time, the nature of other activities that the animal is engaged in when it detects a new stimulus, the hearing capabilities of an animal or species, and numerous other factors (Brumm and Slabbekoorn 2005). Thus, it may be difficult to assign a single criterion above which behavioral responses to noise would occur.

In order to be detected, a sound must be above the “background” level. Additionally, results from some studies suggest that sound may need to be biologically relevant to an individual to elicit a behavioral response. For example, in an experiment on responses of American shad to sounds produced by their predators (dolphins), it was found that if the predator sound is detectable, but not very loud, the shad will not respond (Plachta and Popper 2003). But, if the sound level is raised an additional 8-10 dB, the fish will turn and move away from the sound source. Finally, if the sound is made even louder, as if a predator were nearby, the American shad go into a frenzied series of motions that probably helps them avoid being caught. It was speculated by the researchers that the lowest sound levels were those recognized by the American shad as being from very distant predators, and thus, not worth a response. At somewhat higher levels, the shad recognized that the predator was closer and then started to swim away. Finally, the loudest sound was thought to indicate a very near-by predator, eliciting maximum response to avoid predation. Similarly, results from Doksæter *et al.* (2009) suggest that fish will only respond to sounds that are of biological relevance to them. This study showed no responses by free-swimming herring (Clupea spp.) when exposed to sonars produced by naval vessels; but, sounds at the same received level produced by major predators of the herring (killer whales) elicited strong flight responses. Sound levels at the fishes from the sonar in this experiment were from 197 dB to 209 dB re 1μPa RMS at 1,000 to 2,000Hz.

For purposes of assessing behavioral effects of pile driving at several West Coast projects, NMFS has employed a 150dB re 1 μPa RMS SPL criterion at several sites including the San Francisco-Oakland Bay Bridge and the Columbia River Crossings. Several studies (Andersson *et al.* 2007, Purser and Radford 2011, Wysocki *et al.* 2007) support our use of the 150 dB re 1 μPa RMS as a threshold for examining the potential for behavioral responses. We will use 150 dB re 1 μPa RMS as a guideline for assessing when behavioral responses to pile driving noise may be expected. The effect of any anticipated response on individuals will be considered in the effects analysis below. For the purposes of this consultation we will use 150 dB re 1 μPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects. That is not to say that exposure to noise levels of 150 dB re 1 μPa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of “take” (*i.e.*, harm or harassment) but that there is the potential, upon exposure to noise at this level, to experience some behavioral response. Behavioral responses could range from a temporary startle to avoidance of an ensonified area.

7.2.3 Effects of Noise on Sea Turtles and Sturgeon

The distance travelled by the noise produced by pile installation activities to relevant thresholds for species in the action area has been examined. Noise and pressure levels were examined in relation to the local species and the maximum distance at which any species may be affected was determined with the help of the GARFO Acoustics Tool Excel Sheet (Table 19-22).

Table 19. Proxy Projects for Estimating Underwater Noise

Project Location	**Water Depth (m)**	**Pile Size (inches)**	**Pile Type**	**Hammer Type**	**Attenuation rate (dB/10m)**
Not Available	15	24"	AZ Steel Sheet	Impact	5
Not Available	15	24"	AZ Steel Sheet	Vibratory	5

Table 20. Proxy-Based Estimates for Underwater Noise

Type of Pile	**Hammer Type**	**Estimated Peak Noise Level (dB_{Peak})**	**Estimated Pressure Level (dB_{RMS})**	**Estimated Single Strike Sound Exposure Level (dB_{sSEL})**
24" AZ Steel Sheet	Impact	205	190	180
24" AZ Steel Sheet	Vibratory	182	165	165

Table 21. Estimated Distances to Sea Turtle Injury and Behavioral Thresholds

Type Pile	**Hammer Type**	**Distance (m) to Sea Turtle TTS (SEL weighted) 189 dB_{RMS}**	**Distance (m) to Sea Turtle TTS (Peak SPL) 226 dB_{Peak}**	**Distance (m) to Sea Turtle PTS (SEL weighted) 204 dB_{SEL}**	**Distance (m) to Sea Turtle PTS (Peak SPL) 232 dB_{Peak}**	**Distance (m) to Sea Turtle Behavioral Threshold 175 dB_{RMS}**
24" AZ Steel Sheet	Impact	NA	NA	NA	NA	40.0
24" AZ Steel Sheet	Vibratory	NA	NA	NA	NA	NA

Table 22. Estimated Distances to Sturgeon Injury and Behavioral Thresholds

Type of Pile	**Hammer Type**	**Distance (m) to 206dB_{Peak} (injury)**	**Distance (m) to 150 dB_{sSEL} (surrogate for 187 dBcSEL injury)**	**Distance (m) to Behavioral Disturbance Threshold (150 dB_{RMS})**
24" AZ Steel Sheet	Impact	8.0	70.0	90.0
24" AZ Steel Sheet	Vibratory	NA	40.0	40.0

The noise from the steel sheet piles while using a vibratory hammer will not exceed any of the sea turtle threshold shifts or behavioral thresholds. The noise from the steel sheet piles while using an impact hammer will not exceed the sea turtle temporary (TTS) or permanent threshold shifts (PTS). Exposure to underwater noise levels of 206 dBpeak and 187 dB cSEL can result in injury to sturgeon. In addition to the "peak" exposure criteria, which relates to the energy received from a single pile strike, the potential for injury exists for multiple exposures to noise over a period of time; this is accounted for by the cSEL threshold. The cSEL is not an instantaneous maximum noise level but is a measure of the accumulated energy over a specific period of time (*e.g.*, the period of time it takes to install a pile). When it is not possible to accurately calculate the distance to the 187 dB cSEL isopleth, we calculate the distance to the 150 dB sSEL isopleth. The farther a fish is away from piles being driven, the more strikes it must be exposed to in order to accumulate enough energy to result in injury. At some distance from the pile, a fish is far enough away that, regardless of the number of strikes it is exposed to, the energy accumulated is low enough that there is no potential for injury. For this project, the distance to the 150 dBsSEL isopleth is no greater than 70.0 meters. In order to be exposed to potentially injurious levels of noise during installation of the piles, a sturgeon would need to be within 70.0 meters of the pile being driven to be exposed to this noise for any prolonged time period. This is extremely unlikely to occur as it is expected that sturgeon would modify their behavior at 90.0 meters (as discussed below) from the installed piles and quickly move away from the area before cumulative injury levels are reached.

Behavioral effects, such as avoidance or disruption of foraging activities, may occur in sturgeon exposed to noise above 150 dB RMS and in sea turtles exposed to noise above 175 dB RMS. It is expected that underwater noise levels would be below 150 dB RMS at distances beyond approximately 90.0 meters from the pile being installed, and they would be below 175 dB RMS at distances beyond 40.0 meters. Should sea turtles and sturgeon move into the action area where their acoustic behavioral threshold extends, as described above, it is reasonable to assume that a sturgeon or sea turtle, upon detecting underwater noise levels of 150 dB RMS or 175 dB RMS, respectively, will modify their behavior such that they redirect their course of movement away from the ensonified area and therefore, away from the project site. If any movements away from the ensonified area do occur, it is extremely unlikely that these movements will affect essential sturgeon or sea turtle behaviors (*e.g.*, spawning, resting, migration, nesting), as the area is not a spawning, overwintering, or nesting area, and the rest of the Atlantic Ocean is sufficiently large enough to allow sturgeon and sea turtles to avoid the ensonified area while continuing to forage and migrate. Given the small distance a sturgeon or sea turtle would need to move to avoid the disturbance levels of noise, any effects are too small be able to be meaningfully measured or detected. Therefore, the effects of noise on sturgeon and sea turtles are insignificant.

7.3 Habitat Modification

Sea Turtles

As outlined above, sea turtles may occur in the waters of New York from May to mid November each year when water temperatures are above 15°C, with the largest numbers present from June through October of any year. During the warmer months, most turtles in the Northeast appear to spend the majority of the time in waters between 16 and 49 feet. This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Ruben and Morreale 1999). As the NYOBA has a range in water depth of approximately 23 to 78 feet (Tetra Tech 2019), the NYOBA is likely too deep to be considered suitable for sea turtle foraging in some areas. However, it is possible for foraging sea turtles to be present in the NYOBA and in other portions of the action area. Therefore, effects to foraging sea turtles may occur within the action area and are considered below.

Atlantic sturgeon

Subadult (less than 150cm in total length, not sexually mature, but have left their natal rivers) and adult Atlantic sturgeon undertake seasonal, nearshore (*i.e.*, typically depths less than 50 meters), coastal marine migrations along the United States eastern coastline (Dunton *et al.* 2010, Erickson *et al.* 2011). Based on tagging data, it is believed that beginning in the fall, Atlantic sturgeon undergo large scale migrations to more southerly waters (*e.g.*, off the coast North Carolina, the mouth of the Chesapeake Bay) and primarily remain in these waters throughout the winter (*i.e.*, approximately December through March), while in the spring, it appears that migrations begin to shift to more northerly waters (*e.g.*, waters off New York) (Dovel and Berggren 1983, Dunton *et al.* 2010, Erickson *et al.* 2011). Atlantic sturgeon aggregate in several distinct areas along the Mid-Atlantic coastline; Atlantic sturgeon are most likely to occur in areas adjacent to estuaries and/or coastal features formed by bay mouths and inlets (Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, Stein *et al.* 2004b). These aggregation areas are located within the coastal waters off North Carolina; waters between the Chesapeake Bay and Delaware Bay; the New Jersey Coast; and the southwest shores of Long Island (Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007). Based on five fishery-independent surveys, Dunton *et al.* (2010) identified several "hotspots" for Atlantic sturgeon captures, including an area off Sandy Hook, New Jersey, and off Rockaway, New York. These "hotspots" are aggregation areas that are most often used during the spring, summer, and fall months (Dunton *et al.* 2010, Erickson *et al.* 2011). Areas between these sites serve as migration corridors to and from these areas, as well as to spawning grounds found within natal rivers.

Atlantic sturgeon have been captured near the NYOBA (Figure 24). Based on this information, as well as information on the habitat characteristics of the NYOBA and the distribution of Atlantic sturgeon, opportunistic foraging may occur at this site. While opportunistic foraging may occur at these sites, it is more likely that the NYOBA is used by migrating individuals as they move from foraging, overwintering, and spawning grounds. As the foraging may occur in the NYOBA and other portions of the action area, foraging impacts to Atlantic sturgeon, as a result of project, will be considered below.

7.3.1 Dredging and Benthic Grabs

Dredging and benthic grab sampling can cause effects to sea turtles and Atlantic sturgeon by reducing prey species and altering the existing biotic assemblages and habitat. Dredging sand and benthic grab sampling from NYOBA would temporarily remove all non-mobile benthic fauna from the action footprint. As noted above, the NYOBA is not believed to be an area where Atlantic sturgeon concentrate to forage. However, opportunistic foraging may occur at this site. Atlantic sturgeon feed on a variety of benthic invertebrates. Shellfish typically make up a very small percentage of the prey base of Atlantic sturgeon; Atlantic sturgeon prey primarily on soft bodied invertebrates such as worms (Guilbard *et al.* 2007, Savoy 2007). Since dredging involves removing the bottom material down to a specific depth, dredging is likely to entrain and kill at least some of these potential forage items that may be consumed by Atlantic sturgeon during their migrations. Turbidity and suspended sediments from dredging activities may also affect benthic resources in those areas. Some of the TSS levels expected for the proposed activities (ranging from 5 mg/L to 550 mg/L) exceed the levels shown to have adverse effects on benthic communities (390 mg/L (EPA 1986).

Similar to Atlantic sturgeon, the NYOBA is not known to be an area where sea turtles concentrate to forage; however, based on surveys conducted in the area, potential sea turtle foraging items appear to be present. Young turtles known to be migrating through the Atlantic Ocean have been tracked via satellite; the tracking has shown that the turtles do not linger in these coastal oceanic waters. Finding prey during their migration would simply be a matter of foraging anywhere along their route outside the dredge or bethic grab footprint, which makes up a very small portion of the overall habitat available for foraging within the action area. Of the listed sea turtle species found in the action area, loggerhead and Kemp's ridley sea turtles are the most likely to utilize these areas for feeding, foraging mainly on benthic species, such as crabs and mollusks (Bjorndal 1997, Morreale and Standora 1994). The District's previous Aquatic Biological Monitoring studies have shown that the abundance and diversity of turtle prey items (crabs and mollusks) which can be found at the NYOBA are available throughout the entire NYB. Swimming crabs such as the blue claw and the lady crab are likely capable of avoiding the draghead. Slower moving crabs including spider crabs may be entrained or crushed. Bivalves and other infauna and non-mobile epifauna would be lost. Additionally, jellyfish, the primary foraging item of leatherback sea turtles, are not likely to be affected by dredging activities as jellyfish occur within the upper portions of the water column and away from the sediment surface where dredging will occur. As jellyfish are not likely to be entrained during dredging, there is not likely to be any reduction in available forage for leatherback sea turtles due to the dredging operations. However, as suitable loggerhead and Kemp's ridley sea turtle foraging items may occur on the benthos of the areas, some loggerhead and Kemp's ridley sea turtle foraging may occur at the NYOBA and therefore, may be affected by dredging and benthic grab activities within this portion of the action area.

While some areas may be more desirable to certain turtles and sturgeon due to prey availability, there is no information to indicate that the NYOBA has better foraging habitat than other surrounding areas within the action area. The assumption can be made that turtles and sturgeon are not likely to be more attracted to the NYOBA than to other foraging areas and should be able to find sufficient prey in alternate areas. Depending on the species, recolonization of a dredged area can begin within as short as a month after dredging stops (Guerra-García and García-Gómez 2006). The dredged and benthic grab areas are expected to be completely recolonized by benthic organisms within approximately 12 months after the dredging and benthic grab sampling is complete. These conclusions are supported by a benthic habitat study which examined an area of Sandbridge Shoals following dredging, which concluded that recolonization of the dredged area was rapid, with macrobenthic organisms abundant on the first sampling date following cessation of dredging activities (less than a month later), and that there was no significant difference in macrofaunal abundance or biomass/production between areas that had and had not been dredged (Diaz *et al.* 2006); suggesting that dredging had no long term impact on prey availability. Based on this information, sea turtles and sturgeon should only be exposed to a reduction in forage in the areas where dredging and benthic grab sampling occurs for one to two seasons immediately following dredging and benthic grab sampling. While some of the TSS levels expected for the proposed activities (up to 550 mg/L) may exceed the levels shown to have adverse effects on benthic communities (390 mg/L), the period of dredging and benthic grab sampling is short and within a small portion of the action area so it is not expected to take away a significant portion of habitat for these species. The NYOBA is a dynamic area where we expect sediment suspended by dredging activities to be transported and diffused over a wider area in the system, potentially lessening the effects of prey item burial. While the project may temporarily disrupt normal feeding behaviors for sea turtles by causing them to move to alternate areas, the project is not likely to remove critical amounts of prey resources. Additionally, the area to be affected is small compared to the available foraging habitat within the action area. Suitable foraging items should continue to be available within other portions of the action area at all times.

Based on this and the best available information as presented here, we anticipate that while the dredging and benthic grab sampling activities may temporarily disrupt feeding behaviors for sea turtles and sturgeon within the NYOBA by causing them to move to alternate areas, the action is not likely to remove critical amounts of prey resources from the portion of the action area located in NYOBA. In addition, the dredging and benthic grab sampling activities are not likely to alter the habitat in any way that prevents sea turtles and sturgeon from using the action area as a migratory pathway to other near-by areas that may be more suitable for foraging. Given the limited area where benthic resources will be removed or displaced, and the expectation that dredged or benthic grab sampled area will be fully recovered and available for foraging for at least a year prior to the next event, effects on sea turtles and sturgeon from reductions in benthic resources will be too small to be meaningfully measured or detected, and are therefore insignificant.

7.3.2 Beach Nourishment and Pile Driving

Placement of material at beach nourishment sites and pile driving can affect sea turtles and Atlantic sturgeon by reducing prey species through the alteration of the existing biotic assemblages (*i.e.*, burying existing subtidal benthic organisms (*e.g.*, crabs, clams, mussels)). The pipeline may also lay on the ocean floor causing a temporary reduction in available prey adjacent to the nourishment site. The turbidity from nourishment and pile driving could cause transit plumes to settle on foraging habitat adjacent to the nourishment and pile driving sites. As the purpose of placing dredge material at these sites is to restore or replenish the affected area, in general, the environment in which the material is to be placed can be characterized as an area exposed to high wave energy and thus, erosion, and one devoid of high densities or colonies of benthic organisms (*e.g.*, shellfish beds, mollusks, crabs, SAV). Instead, these sites consist primarily of benthic infaunal communities (*e.g.*, polycheates) that can withstand the variable and continually changing environment. Other preferred prey items or habitat for sea turtles and Atlantic sturgeon (*e.g.*, shellfish beds, crabs, mollusks, areas of SAV) are therefore, rarely established in these areas. Thus, it is extremely unlikely that the placement of dredged material and pile driving in the nearshore waters of New York will result in the removal of critical amounts of prey resources from the area. Should any prey items be removed from the area in which dredged material is to be placed or piles are to be driven, depending on the species, recolonization of a newly renourished beach can begin in as short as two to six months (Burlas *et al.* 2001) when there is a good match between the fill material and the natural beach sediment. As the sand being placed along shorelines is similar in grain size to the indigenous beach sand, it is expected that recolonization of the nearshore benthos will occur within two to six months after initial beach renourishment or shoreline restoration cycles are complete. As such, no long term impacts on the numbers of species or community composition of the beach infauna is expected (Burlas *et al.* 2001). The depths at the pile driving and beach nourishment sites are likely to be shallow and are thus, not the preferred foraging habitat for these species. In addition, beach nourishment or pile driving operations from the proposed projects are not likely to alter the habitat in any way that prevents sea turtles or Atlantic sturgeon from using the action area as a migratory pathway to other areas with more suitable foraging habitat. The area to be affected is small compared to the available foraging habitat within the action area. As such, the consequences of these operations on foraging or migrating sea turtles and Atlantic sturgeon are too small to be meaningfully measured or detected and are insignificant.

7.3.3 Groin Construction

The placement of stone can cause consequences to sea turtles and sturgeon by reducing prey species through the alteration of the existing biotic assemblages and habitat. The turbidity from the groin construction could cause transit plumes to settle on foraging habitat adjacent to the groin construction site. Shallow waters (<10 feet) where the groins will be located are not known to provide optimal foraging for sea turtles (16-49 feet is preferred), and may or may not provide adequate opportunistic foraging for Atlantic sturgeon. In general, minor disruptions or removal of small proportions of benthic habitat associated with these projects that may provide opportunistic foraging habitat will have minimal impacts on the overall availability of suitable foraging habitat for both Atlantic sturgeon and sea turtles throughout the Atlantic Ocean off of New York. These structures are very small compared to the available habitat withing the action area. As such, ample habitat will remain available for both sea turtles and Atlantic sturgeon to opportunistically forage. Additionally, the proposed stone placement operations are not likely to alter the habitat in any way that prevents sturgeon and sea turtles from using any portion of the action area as a migratory pathway and therefore, would not disrupt any essential behaviors such as migrating or foraging. Based on this information, the consequences of stone placement on Atlantic sturgeon and sea turtle migration and foraging are expected to be too small to be meaningfully measured or detected and are insignificant.

In summary, the cumulative loss of habitat from dredging, groin construction, pile driving, and beach nourishement when added together is small compared to the entire action area as a whole. Therefore, the consequences of habitat modification are too small to be meaningfully measured or detected and effects are insignificant.

7.4 Vessel Traffic

A typical beach nourishment project requires the deployment of one hydraulic dredge, one crew boat, two barges, and two tugs, as summarized in Table 4. Origination of vessels is unknown at this time, but, typically, dredge contractors utilize berth and dry-dock facilities close to the project location to offset costs. Dredges, tugs and scows or barges travel at or below 10 kts/hour, while the crew boat may exceed 10 kts/hour, but, will limit speed to less than 20 kts/hour due to fuels costs and safety constraints. The speed of the hopper dredge while dredging at the borrow area will be 2.6 knots.

The decades-long (since 1980s) and ongoing fish trawl element of the biological monitoring program utilizes a 30' (foot) otter trawl, with 1" (inch) mesh and ¾"cod end liner. There has been an average of 120 trawls per sampling season per site (2 days per month) between April and September (6 months) of any year during sand borrow area analyses and construction (sand removal dredging and beach nourishment) operations. Each transect encompasses approximately ¼ nautical miles, or the equivalent of 8-10 minute transects, at an average speed of 2-3 kts. Sampling is usually done every year before and during each dredge event. Sampling is then completed during the two following years after each dredge event.

7.4.1 Background Information on the Risk of Vessels to Sea Turtles

Project vessels will be performing maintenance dredging, beach nourishment, construction, and the aquatic biological monitoring in areas where sea turtles are present. As mentioned, sea turtles are found in the Atlantic Ocean off of New York in the warmer months, generally from May through mid-November.

Boat strikes and propeller hits are probably the greatest source of injury and mortality to sea turtles in coastal areas in the northeast. Most of these are due to the abundance of speeding recreational boats. Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about nine percent of living and dead stranded sea turtles had propeller or other vessel strike injuries (Lutcavage *et al.* 1997). According to the 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a vessel. This number underestimates the actual number of vessel strikes that occur since not every vessel struck turtle will strand, not every stranded turtle will be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a vessel. It should be noted, however, that it is not known whether all vessel strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. Dredges, tugs and scows or barges travel at or below 10 kts/hour, while the crew boat may exceed 10 kts/hour, but, will limit speed to less than 20 kts/hour due to fuels costs and safety constraints. In addition, the risk of vessel strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged.

7.4.2 Background Information on the Risk of Vessels to Sturgeon

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes are currently unknown, but based on what is known for other species we expect they are related to size and speed of the vessels, navigational clearance (*i.e.*, depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of sturgeon in the area (*e.g.*, foraging, migrating, etc.). Geographic conditions (e.g. narrow channels, restrictions, etc.) may also be relevant risk factors. Large vessels have been typically implicated because of their deep draft relative to smaller vessels, which may increase the probability of vessel collision with demersal fishes like sturgeon, even in deep water (Brown and Murphy 2010). Larger vessels also draw more water through their propellers given their large size and therefore may be more likely to entrain sturgeon in the vicinity. However as documented below, sturgeon are also at risk from exposure to smaller vessels with shallower drafts, thus making vessel traffic analyses difficult. Sturgeon are known to breach the surface and are seen over foraging areas where sturgeon congregate. Atlantic sturgeon that ascend to the surface may be exposed to shallow draft vessels. It is believed that one of the reasons for this behavior is related to the fish needing to gulp air to fill their gas or swim bladder (Logan-Chesney *et al.* 2018, Watanabe *et al.* 2008). The need to inflate the swim bladder may be more pronounced and surfacing can occur more often at depths of ≤10 meters as the sharpest change in hydrostatic pressure with lateral movement occurs within this depth range. The number of surfacing events decreases substantially when at deeper depths, and the swim bladder may collapse at depths of 40 meters such that a sturgeon is negatively buoyant, remains near the bottom, and will have to swim actively to move off the bottom (Logan-Chesney *et al.* 2018, Watanabe *et al.* 2008). Since buoyancy is related to hydrostatic pressure, at depths of ≤10 meters, the need for regulating air in the swim bladder to control buoyancy may increase during flooding and ebbing tides when the hydrostatic pressure changes rapidly. Logan-Chesney *et al.* (2018) found in their study that about half of the recorded surfacing events occurred during flood tide, from mid- to high-tide, and the maximum number of breach events occurred between 23:00 and 03:00. Sturgeon actively swim when ascending and descending at swim speeds ranging from 0.17 to 3.17 m/s. Thus, the ability to avoid approaching vessels may be limited when ascending.

Atlantic sturgeon interactions with vessels have been documented in the James River (Balazik *et al.* 2012c). The Balazik *et al.* (2012c) study was conducted in the freshwater portion of the James River from 2007-2010 and 31 carcasses of adult Atlantic sturgeon were used in the study. Twenty-six of the carcasses had scars from propellers and five were too decomposed to determine the cause of death. Nearly all of the carcasses were recovered (84%) from a narrow reach of the river near Turkey Island (RM 75) that was modified to enhance shipping efficiency. Balazik *et al.* (2012c) indicated that the vessel interactions were likely caused by deep draft vessels because of the benthic nature of Atlantic sturgeon based on the telemetry study. Balazik and Garman (2018) suggest that a high percentage of reports (unpublished) of dead Atlantic sturgeon may be interacting with vessels in the Thimble Shoals portion of the Chesapeake Bay which is one of the entrance channels into the James River. This area can support deep-draft vessels, and telemetry studies indicate that migrating sturgeon use the channel to enter the river system.

Miranda and Killgore (2013) estimated that the large towboats on the Mississippi River, which have a propeller diameter of eight feet, a draft of up to nine feet, and travel at approximately the same speed as tugboats (less than ten knots), kill a large number of fish by drawing them into the propellers. They indicated that shovelnose sturgeon (*Scaphirhynchus platorynchus*), a small sturgeon (~50-85 cm in length) with a similar life history to shortnose sturgeon, were being killed at a rate of 0.02 individuals per kilometer traveled by the towboats.

As the Mississippi River and the Atlantic Ocean differ significantly, and as we do not have the data necessary to compare shovelnose sturgeon densities in the Mississippi to Atlantic sturgeon populations off of Long Island, this estimate cannot directly be used for this analysis. We also cannot modify the rate for this analysis because we do not know (a) the difference in traffic on the Mississippi River and the Atlantic Ocean; (b) the difference in density of shovelnose sturgeon and Atlantic sturgeon; and, (c) if there are risk factors that increase or decrease the likelihood of strike in the Atlantic Ocean. However, this information does suggest that large vessel traffic can be a major source of sturgeon mortality. In larger water bodies like the Atlantic Ocean, it is less likely that fish would be killed since they would have to be close to the propeller to be drawn in. In a relatively shallow or narrow area, a big vessel with a deep draft and a large propeller would leave little space for a nearby fish to maneuver.

Although smaller vessels have a shallower draft and entrain less water, they often operate at higher speeds, which is expected to limit a sturgeon's opportunity to avoid being struck. There is evidence to suggest that small fast vessels with shallow drafts are a source of vessel strike mortality on Atlantic sturgeon. On November 5, 2008, in the Kennebec River, Maine, Maine Department of Marine Resources (MEDMR) staff observed a small (<20 foot) boat transiting a known shortnose sturgeon overwintering area at high speeds. When MEDMR approached the area after the vessel had passed, a fresh dead shortnose sturgeon was discovered. The fish was collected for necropsy, which later confirmed that the mortality was the result of a propeller wound to the right side of the mouth and gills. In another case, a 35-foot recreational vessel travelling at 33 knots on the Hudson River was reported to have struck and killed a 5.5 foot long Atlantic sturgeon (NYSDEC sturgeon mortality database (9-15-14)). A tugboat moving at about 11 knots was observed striking and killing an adult Atlantic sturgeon female in the Delaware Bay in 2016 (Ian Park, DENRC, personal communication, June 2017). Additionally, Barber (2017) found correlations between channel morphology and vessel strike risk in the James River. Because risk varies depending on a number of factors, speed from smaller vessels may pose risk at similar levels as deep-draft vessels depending on the physical environment where the fish are found. Given these incidents, we conclude that interactions with vessels are not limited to large, deep draft vessels.

7.4.3 Effects of Project Vessel Traffic on Sea Turtles and Atlantic Sturgeon

There is the potential for sea turtles and sturgeon to be killed or injured by interacting with transiting vessels associated with the action. We have considered the likelihood that an increase in vessel traffic associated with the project increased the risk of interactions between sea turtles and Atlantic sturgeon and vessels in the project area, when added to the baseline conditions.

While it is your conclusion that there is a net gain of zero vessels added to the action area due to the dredging operations established exclusionary zones implementation as well as the mandatory reduced speed of those vessels (as opposed to non-project-related vessels), to be conservative, we will assume that the proposed Federal action will add as many as six project vessels for each dredging, beach nourishment, construction, and biological monitoring event (see Table 4 for frequency of projects). You estimated that during the dredging and beach nourishment activities, the barges/tugs will make seven trips per project and the dredge will make eight trips per day year-round for the first dredge event and from October-April of each following year when renourishment events will occur until potentially 2037. In the information you provided on March 19, 2020, you indicated that the biological sampling trawling involves an otter trawl and has been done an average of 120 trawls per sampling season per project site (two days per month) between April and September of each year until potentially 2039 (depending on the project). We (NMFS) do not expect all of these vessels to be operating at once, as many of them perform the same purpose, and we understand them to be part of a rotation depending on availability, costs, and ocean conditions.

Most reported vessel strikes of sturgeon have been associated with relatively confined areas, such as shipping channels, where the bottom of the hull and the propellers are relatively close to the sea bottom. This would not be the case at NYOBA during dredging, construction, or monitoring activities, including along the transit route to the booster (pump out) station. The depths that exist at the borrow area along the route to the booster would not bring the vessel or its propellers into proximity of the bottom since the vessels do not typically sail into areas where maximum water depth is not at least six feet greater than the maximum vessel draft. These are extensive flat areas that would not bottleneck sea turtles and sturgeon and necessarily bring them close to a vessel.

Since sturgeon are demersal and remain on or near the bottom most of the time, their foraging and migratory behavior should keep them well below any vessels (in sufficiently deep water) (Fisher 2011, Balazik et al. 2012, Reine et al. 2014). However, Atlantic sturgeon that ascend to the surface may be exposed to shallow draft vessels. This behavior likely accounts for an extremely low proportion of daily activity as a single sturgeon gulps air from zero to 12 times a day and each event is of short duration (seconds) (Logan-Chesney 2018). For an ascending sturgeon to interact with one of the project vessels, the two have to be at the exact same spot (within a few feet) at the exact same time (seconds). Therefore, the probability of a project vessel striking an ascending sturgeon is extremely low given the large expanses of ocean where the vessels operate.

Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. An experienced protected species observer who could advise the vessel operator to slow the vessel or maneuver safely if sea turtles were spotted will be on board for all the dredging operations which further reduces the potential risk for interaction with vessels.

As noted, dredging operations and biological monitoring typically adds approximately six vessels to the action area at one time. However, we acknowledge that implementation of established exclusionary zones during dredging opersations may reduce the presence of non-dredge vessels within the action area. Thus, while the proposed action will cause an increase in vessel traffic the addition of these project-related vessels will be intermittent, temporary, and restricted to a small portion of the overall action area on any day dredging occurs. Once dredging and biological sampling is completed, the pre-project status quo of likely vessel numbers and vessel traffic patterns will remain, and, thus, not permanently increase the number of vessels. Given the large volume of traffic in the project area, the increase in traffic associated with the project is extremely small.

Given that the action area is in a coastal environment where listed species are able to disperse widely, and due to the temporary and localized operation of the vessels associated with the Federal action, the probability that a project vessel will strike a sturgeon or sea turtle is extremely low.

7.5 Risk of Entrainment from Dredging

7.5.1 Risk of Entrainment in Hydraulic Cutterhead Dredges

Some of the future dredging at the NYOBA may be accomplished with a cutterhead dredge. The exact dredge (cutterhead or hopper) to be used on a given project depends upon dredge contractor equipment availability at the time of award.

The cutterhead dredge operates with the dredge head buried in the sediment; however, a flow field is produced by the suction of the operating dredge head. The amount of suction produced is dependent on linear flow rates inside the pipe and the pipe diameter (USACE https://dots.el.erdc.dren.mil/doer/tools.html). High flow rates and larger pipes create greater suction velocities and wider flow fields. The suction produced decreases exponentially with distance from the dredge head (Boysen and Hoover 2009). With a cutterhead dredge, material is pumped directly from the dredged area to a beach nourishment site. As such, there is no opportunity to monitor for biological material on board the dredge; rather, observers work at the disposal site to inspect material.

Sea Turtles

Sea turtles are not known to be vulnerable to entrainment in cutterhead dredges, presumably because they are able to avoid the relatively small intake and low intake velocity. Thus, if a sea turtle were to be present at the dredge site, it would be extremely unlikely that cutterhead dredging operations would result in injury or mortality of a turtle.

Atlantic Sturgeon

While entrainment of smaller sturgeon in cutterhead dredges has been observed (as evidenced by the presence of a few individual shortnose sturgeon at the Money Island Disposal Site in the Delaware River in 1996 and 1998), these instances are rare and have been limited to dredging events that occur near sturgeon overwintering areas where sturgeon are known to form dense aggregations of lethargic sturgeon that are less likely to respond to disturbance. However, although sturgeon may be present in the action area year round, the action area is not a known overwintering area for Atlantic sturgeon. The risk of entrainment is also higher for small fish, including early life stages and small juveniles. Because these life stages are not present in the action area and the smallest sturgeon present would be at least 2.3 feet (the size at which we expect them to begin migrations from their natal river), the risk of entrainment is minimal in the action area. Increased risk factors (*i.e.*, small fish, overwintering area) are not present in the action area, overall.

Cutterhead dredges operate with the dredge intake buried in the sediment; therefore, in order to have contact with the dredge intake, sturgeon would have to be on the bottom. It is generally assumed that adult and subadult Atlantic sturgeon are mobile enough to avoid the suction of an oncoming cutterhead dredge and that any adult or subadult sturgeon in the vicinity of such an operation would be able to avoid the intake and escape. Several studies offshore of New York and Long Island (Dunton 2014, Erickson *et al.* 2011, Ingram *et al.* 2019) as well as offshore of North Carolina (Laney *et al.* 2007) have also suggested that sturgeon in those offshore aggregation areas are unlikely to be stationary. Laney *et al.* (2007) did a tagging and recapture study that confirmed that subadult Atlantic sturgeon wintering off of North Carolina travel widely and represent several stocks. In New York, tagging work by Erickson *et al.* (2011) showed that adult Atlantic sturgeon from the Hudson River move about within the Mid-Atlantic Bight, occurring as far south as Delaware for the late fall to early winter and then as far south as the area off Chesapeake Bay for the latter part of the winter. The data do not suggest movement from the river to a specific overwintering area where the fish reside throughout the winter. Dunton (2014) did a tag and recapture study for sturgeon that were initially sampled off the southern coast of Long Island. For the sturgeon that were recaptured by state, federal, and academic agencies, the days at large ranged from 0.3 to 929 days while estimated distances from the original tagging locations ranged from 1-542 km. For the sturgeon that were recaptured by commercial and recreational fisheries, the estimated distance from the original tagging sites ranged from 1-293 km while days at large ranged from 26-245 days (Dunton 2014). Ingram *et al.* (2019) found that sturgeon residency in the New York Wind Energy Area was uncommon and of short durtation (average of 10.1 hours) which suggests that daily mixing of sturgeon could occur.

Taylor *et al.* (2016) did a study that suggests that Atlantic sturgeon remain stationary when they arrive at offshore aggregation sites off of nearby estuaries especially in the winter. We have also received three reports from the shrimp trawl fishery in the Gulf of Maine where Atlantic sturgeon were captured in the winter. These findings, however, all occurred offshore of Saint John estuary. Because the areas to be dredged along south shore of Long Island are far from the mouth of the Hudson River, it is unlikely the sturgeon that are present are stationary.

The risk of entrainment is believed to be highest in areas/environments where the movements of animals are restricted (*e.g.*, rivers, narrow confined channels, small semi-enclosed harbors) and therefore, where the animal has limited opportunity to move away from the dredge. If these restricted areas also occur within sites where species are known to concentrate, the likelihood of an interaction further increases. These characteristics; however, are not present within the action area. The NYOBA is situated within the Atlantic Ocean, an area we consider an open ocean environment; that is, an unconfined, body of water in which the shorelines of the surrounding land masses do not encroach on the body of water to an extent that narrow waterways are created.

The risk of an individual sturgeon being entrained in a cutterhead dredge is difficult to calculate. While a large area overall will be dredged, the dredge operates in an extremely small area at any given time (i.e., the ocean bottom in the immediate vicinity of the intake). As Atlantic sturgeon are well distributed throughout the action area and an individual would need to be in the immediate area where the dredge is operating to be entrained (*i.e.*, within one meter of the dredge head) (Clarke 2011), the overall risk of entrainment is low. It is extremely unlikely that any Atlantic sturgeon in the action area will ever encounter the dredge as they would not occur within one meter of the dredge.

7.5.2 Risk of Entrainment in Hopper Dredges

Hopper dredges are self-propelled seagoing vessels that are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and trailing suction drag-heads required to perform their essential function of excavating sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredge against strong currents. They also have excellent maneuverability.

Dredged material is raised by dredge pumps through dragarms connected to drags in contact with the channel bottom and discharged into hoppers built in the vessel. Hopper dredges are equipped with large centrifugal pumps similar to those employed by other hydraulic dredges. Suction pipes (dragarms) are hinged on each side of the vessel with the intake (drag) extending downward toward the stern of the vessel. The forward moving vessel moves the drag along the bottom at speeds up to three mph (2.6 knots). The dredged material is sucked up through the pipe and deposited and stored in the hoppers of the vessel.

A hopper dredge removes material from the bottom of the channel in relatively thin layers, usually 2-12 inches, depending upon the density and cohesiveness of the dredged material. Pumps located within the hull, but sometimes mounted on the dragarm, create a region of low pressure around the dragheads and force water and sediment up the drag arm and into the hopper. The more closely the draghead is maintained in contact with the sediment, the more efficient the dredging, provided sufficient water is available to slurry the sediments. Hopper dredges can efficiently dredge non-cohesive sands and cohesive silts and low-density clay. Draghead types may consist of IHC and California type dragheads.

California type dragheads sit flatter in the sediment than the IHC configuration which is more upright. Individual draghead designs (*i.e.*, dimensions, structural reinforcing/configuration) vary between dredging contractors and hopper vessels. Port openings on the bottom of dragheads also vary between contractors and draghead design. The port geometry is typically rectangular or square with minimum openings of ten inch by ten inch or twelve inch by twelve inch or some rectangular variation.

Industry and government hopper dredges are equipped with various power and pump configurations and may differ in hopper capacity with different dredging capabilities. An engineering analysis of the known hydraulic characteristics of the pump and pipeline system on the USACE hopper dredge "Essayons" (a 6,423 CY hopper dredge) indicates an operational flow rate of forty cubic feet per second with a flow velocity of eleven feet per second at the draghead port openings. The estimated force exerted on a one-foot diameter turtle (*i.e.*, one-foot diameter disc shaped object) at the pump operational point in this system was estimated to be twenty-eight pounds of suction or drag force on the object at the port opening of the draghead.

Dredging is typically parallel to the centerline or axis of the channel. Under certain conditions, a waffle or crisscross pattern may be utilized to minimize trenching or during clean-up dredging operations to remove ridges and produce a more level channel bottom. This movement up and down the channel while dredging is called trailing and may be accomplished at speeds of 1-3 knots, depending on the shoaling, sediment characteristics, sea conditions, and numerous other factors. In the hopper, the slurry mixture of the sediment and water is managed by a weir system to settle out the dredged material solids and overflow the supernatant water. When an economic load is achieved, the vessel suspends dredging, the drag arms are raised, and the dredge travels to the designated placement site. Because dredging stops during the trip to the placement site, the overall efficiency of the hopper dredge is dependent on the distance between the dredging location and placement sites; the more distance to the placement site, the less efficient the dredging operation resulting in longer contract periods to accomplish the work.

Sea turtle deflectors utilized on hopper dredges are rigid V-shaped attachments on the front of the dragheads and are designed and intended to plow the sediment in front of the draghead. The plowing action creates a sand wave that rolls in front of the deflector. The propagated sand wave is intended to shed a turtle away from the deflector and out of the path of the draghead. The USACE modeled and field-tested the effectiveness of the rigid deflector design and its ability to reduce entrainment during the 1980s and early 1990s (Banks and Alexander 1994, Nelson and Shafer 1996). The deflectors are most effective when operating on a uniform or flat bottom. Presence of significant ridges and troughs that prevent the deflector from plowing and maintaining the sand wave and the dragheads from maintaining firm contact with the bottom may diminish the deflector effectiveness.

The scope of the Proposed Action comprises multiple contracts, utilizing medium to large volume hopper dredge equipment to remove sand from the NYOBAs for placement via pipeline on the shoreline. The equipment likely to be utilized for these projects are of similar size and capacity used in recent previous hydraulic dredge projects in the region, depending upon dredge contractor equipment availability at the time of award. You have stated that a hydraulic cutterhead dredge may be used occasionally. However, it has not been determined how often it will be used, in what borrow areas it will be used, or the volume if any that may be dredged with a hydraulic dredge. Therefore, to be conservative, we assume the worst case scenario that all dredging will occur with a hopper dredge. The last remaining renourishment sand contract for

LB will be completed in 2037 (Table 4). The volume of renourishment fill needed for LB is 1,770,000 CY. The dredging for FIMI has been completed. For the ER, a total beach fill quantity of 804,000 CY will be dredged for the initial placement, including tolerance, overfill and advanced nourishment with a renourishment cycle of 2,300,000 CY to be dredged. The last renourishment event for ER is expected to be completed in 2037. For FIMP, a total beach fill quantity of 4,200,000 CY will be dredged for the initial placement, with the initial contract beginning in 2021. The renourishment cycle will involve dredging 3,000,000 CY with the final renourishment contract concluding in 2037. The initial dredge events could occur year-round anytime from October-September. The renourishment events will only occur from October to March of any year. For LB and ER, the renourishment cycles are expected to occur every four years, and for FIMP, the renourishment cycle is expected to occur every three years plus have three additional events during that time.

7.5.2.1 Entrainment in Hopper Dredges – Sea Turtles

Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the draghead. Dredging operations within the NYOBA will involve the use of a medium to large volume hopper dredge. Given their large size, leatherback sea turtles are not vulnerable to entrainment in hopper dredges. To date, there have only been three reported leatherback sea turtle takes from a hopper dredge. There were two from a dredge in 2016 during the Town of Hilton Head Island beach renourishment project in the South Atlantic region, and one from a 2020 dredging project in North Carolina. To date, there have been no reported leatherback sea turtle takes in the North Atlantic region (USACE ODESS, last accessed April 14, 2020). Therefore, this section of the Opinion will only consider the effects of entrainment on loggerhead, Kemp's ridley, and green sea turtles. Sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, with loggerhead and Kemp's ridley sea turtles being the most common species in these waters. Although not expected to be as numerous as loggerheads and Kemp's ridleys, green sea turtles are also likely to occur seasonally in the NYOBA.

Most sea turtles are able to escape from the oncoming draghead due to the slow speed that the draghead advances (up to 3 mph or 4.4 feet/second). Interactions with a hopper dredge result primarily from crushing when the draghead is placed on the bottom or when an animal is unable to escape from the suction of the dredge and becomes stuck on the draghead (impingement). Entrainment occurs when organisms are sucked through the draghead into the hopper. Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

Interactions with the draghead can also occur if the suction is turned on while the draghead is in the water column (*i.e.*, not seated on the bottom). You implemented procedures to minimize the operation of suction when the draghead is not properly seated on the bottom sediments which reduces the risk of these types of interactions.

Sea turtles may become entrained in hopper dredges as the draghead moves along the bottom. Because entrainment is believed to occur primarily while the draghead is operating on the bottom, it is likely that only those species feeding or resting on or near the bottom would be vulnerable to entrainment. Turtles can also be entrained in the suction current flow while the draghead is being placed or removed, or if the dredge is operating on an uneven or rocky substrate and rises off the bottom. Recent information from the USACE suggests that the risk of entrainment is highest when the bottom terrain is uneven or when the dredge is conducting "clean up" operations at the end of a dredge cycle when the bottom is trenched and the dredge is working to level out the bottom. In these instances, it is difficult for the dredge operator to keep the draghead buried in the sand and sea turtles near the bottom may be more vulnerable to entrainment.

There is some evidence to indicate that turtles can become entrained in trunions or other water intakes (Nelson and Shafer 1996). For example, a large piece of a loggerhead sea turtle was found in a UXO screening basket on Virginia Beach in 2013. The hopper dredge was operated with UXO screens on the draghead designed to prevent entrainment of any material with a diameter greater than 1.25". The pieces of turtle found were significantly larger. Because an inspection of the UXO screens revealed no damage, it is suspected that the sea turtle was entrained in another water intake port. According to the USACE, the New York coastline is not a designated area that requires UXO screens, so they do not mandate their use there. The USACE does mandate the use of screening of all portholes and other inlets that could intake a small individual so as to permit the ESA observer to inspect these areas, as well as the hopper intake area and baskets for such evidence.

Background Information on Entrainment of Sea Turtles in Hopper Dredges

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the US. Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; *i.e.*, south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) (USACE ODESS, last accessed April 17, 2020) presumably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. According to ODESS, in the USACE SAD, approximately 627 sea turtles have been entrained in hopper dredges since 1980. Records of sea turtle entrainment in the USACE NAD begin in 1993. Through November 2016, 78 sea turtles takes (Table 23) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE ODESS, last accessed April 17, 2020); the majority of these turtles have been entrained in hopper dredges operating in Chesapeake Bay. It should be noted that the ODESS database does not identify whether the takes were lethal or not. It is also unclear whether all hopper takes within the regions have been entered into ODESS.

Table 23. Reported Sea Turtle Takes in USACE NAD Hopper Dredging Operations from 1993-2016 (USACE ODESS, last accessed April 17,2020). Note: Takes labeled as "unknowns" were left out, because it is unclear whether they were sea turtles or sturgeon.

Project/Location	**Year(s) of Operation**	**Cubic Yardage Removed**	**Observed Takes**
Long Beach Island, NJ	2015-2016	Unknown	1 loggerhead
York Spit	2015	Unknown	6 loggerheads

Project/Location	Year(s) of Operation	Cubic Yardage Removed	Observed Takes
Thimble Shoals/Cape Henry	2014-2015	Unknown	1 Kemp's ridley 3 loggerheads
Cape Henry	2011-2012	Unknown	1 loggerhead
York Spit Channel	2011-2012	145,332	1 loggerhead
Thimble Shoals/York Spit	2010-2012	Unknown	1 loggerhead
Thimble Shoal Channel	2009	Unknown	3 loggerheads
York Spit Channel	2007	608,000	1 Kemp's ridley
Cape Henry	2006	Unknown	3 loggerheads
Thimble Shoal Channel	2006	Unknown	1 loggerhead
Thimble Shoal Channel & Virginia Beach	2003	1,828,312	1 Kemp's ridley 7 loggerheads
York Spit Channel	2002	911,406	1 Kemp's ridley 8 loggerheads
Cape Henry	2002	1,407,814	1 green 1 Kemp's ridley 6 loggerheads
Virginia Beach Hurricane Protection Project	2002	Unknown	1 loggerhead
Cape Henry	2001-2002	1,641,140	1 Kemp's ridley 2 loggerheads
Virginia Beach Hurricane Protection Project	2001	Unknown	5 loggerheads
Sandbridge Beach	2001-2013	Unknown	1 loggerhead
Thimble Shoal Channel	2000	831,761	2 loggerheads
York River Entrance Channel	1998	672,536	6 loggerheads
Sandy Hook to Barnegat Inlet (Section I)	1997	Unknown	1 loggerhead
Thimble Shoal Channel	1996	529,301	1 loggerhead
Delaware River Navigation Channel	1995	218,151	1 loggerhead
York Spit Channel	1994	61,299	4 loggerheads
Delaware River Navigation Channel	1994	Unknown	1 loggerhead
Cape Henry	1994	552,671	4 loggerheads
Cape May Inlet Beachfill – New Jersey/ Delaware City	1993	Unknown	1 loggerhead
			TOTAL: 78 Turtles

Interactions are likely to be most numerous in areas where sea turtles are resting or foraging on the bottom. When sea turtles are at the surface, or within the water column, they are not likely to interact with the dredge because there is little, if any, suction force in the water column. Sea turtles have been found resting on the ocean bottom in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. Chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Habitat in the action area is not consistent with areas where sea turtle brumation has been documented; therefore, we do not anticipate any sea turtle brumation in the action area. Very few interactions with sea turtles have been recorded offshore of New York. This may be because the area where the dredge is operating is more wide-open providing more opportunities for escape from the dredge as compared to a narrow river or harbor entrance.

On a hopper dredge without UXO screens, it is possible to monitor entrainment because the dredged material is retained on the vessels as opposed to the direct placement of dredged material both overboard or in confined disposal facilities by a hydraulic pipeline dredge. A hopper dredge contains screened inflow cages from which an observer can inspect recently dredged contents. Typically, the observer inspection is performed at the completion of each load while the vessel is transiting to the authorized placement area and does not affect production of the dredging operations.

Before 1994, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk District. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. According to ODESS, since 1993, the take of five sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore, and New York Districts.

It should be noted that the observed takes may not be representative of all the turtles killed during dredge operations. Formerly, endangered species observers were required to observe a total of 50 percent of the dredge activity (*i.e.,* 8 hours on watch, 8 hours off watch). As such, if the observer was off watch or the cage was emptied and not inspected or the dredge company either did not report or was unable to identify the turtle incident, there is the possibility that a turtle could be taken by the dredge and go unnoticed. Additionally, in older Opinions (*i.e.,* prior to 1995), we frequently only required 25% observer coverage and monitoring of the overflows which has since been determined to not be as effective as monitoring of the intakes. These conditions may have led to sea turtle takes going undetected.

We raised this issue to the USACE Norfolk District during the 2002 season, after several turtles were taken in the Cape Henry and York Spit Channels, and expressed the need for 100 percent observer coverage. On September 30, 2002, the USACE informed the dredge contractor that when the observer was not present, the cage should not be opened unless it is clogged. This modification was to ensure that any sea turtles that were taken on the intake screen (or in the cage area) would remain there until the observer evaluated the load. The USACE's letter further stated "Crew members will only go into the cage and remove wood, rocks, and man-made debris; any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer is the only one allowed to clean off the overflow screen. This practice provides us with 100 percent observation coverage and shall continue." Theoretically, all sea turtle parts were observed under this scheme, but the frequency of clogging in the cage is unknown at this time. The most effective way to ensure that 100 percent observer coverage is attained is to have a NMFS-approved endangered species observer monitoring all loads at all times. This level of observer coverage would document all turtle interactions and better quantify the impact of dredging on turtle populations.

It is likely that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles were stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Marine Science Museum (VMSM) found 10 loggerheads, two Kemp's ridleys, and one leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While it cannot be conclusively determined that these strandings were the result of dredge interactions, the link is possible given the location of the strandings (*e.g.,* in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (*e.g.*, crushed or shattered carapaces and/or flipper bones, black mud in mouth). Additionally, in 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located three miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. It is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper and then were discharged onto the beach with the dredge spoils. A dredge could crush an animal as it was setting the draghead on the bottom, or if the draghead was lifting on and off the bottom due to uneven terrain, but the actual cause of these crushing injuries cannot be determined at this time. Further analyses need to be conducted to better understand the link between stranded sea turtles with evidence of injury from crushing and dredging activities, and if those strandings need to be factored into an incidental take level. Regardless, it is possible that dredges are taking animals that are not observed on the dredge which may result in strandings on nearby beaches.

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation.

Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years as noted above in the examples of sea turtle takes. Dredging operations may go on for months, with sea turtle takes occurring intermittently throughout the duration of the action. For example, dredging occurred at Cape Henry over 160 days in 2002 with eight sea turtle takes occurring over three separate weeks while dredging at York Spit in 1994 resulted in four sea turtle takes in one week. In Delaware Bay, dredge cycles have been conducted during the May-November period with no observed entrainment and as many as two sea turtles have been entrained in as little as three weeks. Even in locations where thousands of sea turtles are known to be present (*e.g.*, Chesapeake Bay) and where dredges are operating in areas with preferred sea turtle depths and forage items (as evidenced by entrainment of these species in the dredge), the numbers of sea turtles entrained is an extremely small percentage of the likely number of sea turtles in the action area. This is likely due to the distribution of individuals throughout the action area, the relatively small area which is affected at any given moment and the ability of some sea turtles to avoid the dredge even if they are in the immediate area.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). Uneven terrain or spot dredging (e.g., when the dredge is moved around to target smaller areas that need dredging) may also influence the number of interactions as interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

As noted above, sea turtles are likely to be less concentrated in the action area for this consultation than they are in areas under the jurisdiction of the Norfolk District (*e.g.*, Chesapeake Bay). Based on this information, NMFS believes that hopper dredges operating in the NYOBA are less likely to interact with sea turtles than hopper dredges operating in areas under the jurisdiction of the Norfolk District (*e.g.*, Chesapeake Bay). As a result, all Norfolk District hopper dredging projects will not be considered further in our analysis as they do not accurately reflect the potential rate of entrainment for projects that occur in areas where sea turtles are not as concentrated.

It is most appropriate to look at other hopper dredging projects that have been undertaken in similar environments or with similar geographic characteristics as the NYOBA to determine a comparable level of potential sea turtle entrainment. As evidenced in ODESS, very few sea turtles have been entrained in hopper dredges operating at any offshore borrow area. This is true even in the southeast, where large numbers of sea turtles are present year round. This is likely due to the transitory nature of most sea turtles occurring in offshore borrow areas as well as the widely distributed nature of sea turtles in offshore waters. Some operations in similar environments have, and still are, operated with a UXO screen on the draghead of the hopper. It should also be noted that UXO screens are used when dredging borrow areas to obtain sand for beach nourishment. The UXO screens effectively hinder turtles from entering the dredge and only smaller turtle parts may be transported through the dredge. Thus, observers are unlikely to be able to record any turtle mortalities. Large pieces of a sea turtle were observed entrained within a dredge equipped with a UXO screen at Sandbridge Shoal, VA. The dredge was inspected after the incident and it was determined that the UXO screen was not damaged. Upon closer examination of the engineering design of the draghead and dredge assembly, it is possible that the sea turtle may have entered through ports or "trunions" that surround the draghead itself.

Despite this information, we still believe that UXO screens are likely to preclude an observer from detecting all entrained sea turtle or sea turtle parts. Accordingly past observer records from these projects are not appropriate to use in our assessment as they may not reliably and accurately reflect entrainment in relation to the cubic yards of material removed.

As the NYOBA is located in an "offshore"/nearshore environment in the waters of the Atlantic Ocean, we looked at all hopper dredging projects in the NAD, excluding the Norfolk District, that had comparable environmental or geographic characteristics of this area to use as baseline information on the levels of sea turtle entrainment that have occurred in these areas/environments. The most appropriate projects to consider were those undertaken in offshore/nearshore (*i.e.*, within 10 miles off the U.S. Eastern coastline) environments or open estuarine environments (Table 24). We did not consider riverine or enclosed to semienclosed bays or estuaries in our assessment as we do not feel the environmental characteristics of these areas are comparable to open estuarine or offshore environments and thus, the level of entrainment in these areas would not be comparable to the level of entrainment that may occur in the NYOBA.

We have compiled records for 21 projects occurring during "sea turtle season" (*i.e.*, May – November 15th) in the Baltimore, Philadelphia, and New York District. As noted above, all projects listed in Table 24 are located in environments that are comparable to that of the NYOBA and report the cubic yardage removed during a project; however an important caveat is that observer coverage for some of these projects ranged from 0 to 50 percent (Table 24).

As explained above, for projects prior to 1995, observers were only present on the dredge for every other week of dredging. For dredging undertaken since 1995, observers were present on board the dredge full time and worked an 8-hour on, 8-hour off shift. Since 2002, the only time that cages (where sea turtle parts are typically observed) were cleaned by anyone other than the observer was when there was no observer present and the cage was clogged. If a turtle or turtle part was observed in such an instance, crew were instructed to leave any biological material in the cage and inform the observer, even if off-duty. As such, it is reasonable to expect that even though the observer was on duty for only 50 percent of the dredge hours, an extremely small amount of biological material went unobserved. To make the data from the 1993 and 1994 dredge events when observers were only on board every other week, comparable to the 1995-2006 data when observers were on board full time, we have assumed that an equal number of turtles were entrained when observers were not present. This calculation is reflected in Table 24 as the "adjusted entrainment number."

Table 24. Offshore hopper Dredging Projects in USACE NAD 1995-2009 without UXO screens (with recorded cubic yardage and sea turtle entrainment; all Norfolk District projects and projects with unknown CY dredged were removed).[7]

Project Location	**Year of Operation**	**Cubic Yards Removed**	**Observed Entrainment**	**Adjusted Entrainment Number**
Dewey and Bethany Beach (DE)	2009	397,956	0	0
Sandy Hook Channel	2008	23,500	0	0
Dewey Beach/Cape Henlopen (DE Bay)	2005	1,134,329	0	0
Delaware Bay	2005	50,000	2 loggerheads	2 loggerheads
Cape May Point, NJ	2005	2,425,268	0	0
Off Ocean City, MD	2002	744,827	0	0
East Rockaway Inlet, NY	2002	140,000	0	0
Off Ocean City MD	1998	1,289,817	0	0
Westhampton, NY (offshore borrow site)	1997	884,571	0	0
Offshore New Jersey	1997	3,700,000	1 loggerhead	1 loggerhead
East Rockaway Inlet, NY	1996	2,685,000	0	0
Westhampton, NY (offshore borrow site	1996	2,518,592	0	0
Delaware Bay	1995	218,151	1 loggerhead	1 loggerhead
East Rockaway Inlet, NY	1995	412,000	0	0
Bethany Beach (DE Bay)	1994	184,451	0	0
Dewey Beach (DE Bay)	1994	624,869	0	0
Off Ocean City, MD	1994	1,245,125	0	0
Westhampton, NY (offshore borrow site)	1993	1,455,071	0	0
Off Ocean City, MD	1992	1,592,262	3 loggerheads	6 loggerheads
Off Ocean City, MD	1991	1,622,776	0	0
Off Ocean City, MD	1990	2,198,987	0	0
	TOTAL	**25,547,552 CY**	***7 loggerheads***	***10 loggerheads***

[7] All projects were operating during "sea turtle season" (*i.e.*, May to November 15). Additionally, only dredges

Predicted Sea Turtle Entrainment in Proposed Hopper Dredging

Based on the data presented in Table 24, we have made calculations which indicate that an average of one sea turtle is killed for approximately every 2,600,000 cubic yards of material removed by a hopper dredge in environments similar to, or like, the NYOBA[8]. This calculation is based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all open estuarine or "offshore" areas that all hopper dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the May to November time frame. Based on these calculations, we expect that for dredging in the NYOBA during the time of year when sea turtles are likely to be present, one sea turtle is likely to be entrained for every 2,600,000 million cubic yards of material removed by a hopper dredge. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of sea turtles from multiple projects over several years, all of which have had observer coverage.

Sea turtle species likely to be entrained

With the exception of one green turtle entrained in a hopper dredge operating in Chesapeake Bay, all other sea turtles entrained in dredges operating in the USACE NAD have been loggerheads and Kemp's ridley. Of these 78 sea turtles, 71 have been loggerhead (91 percent), six have been Kemp's ridleys (8 percent), and one green (1 percent). No Kemp's ridleys or greens have been entrained in dredge operations outside of the Chesapeake Bay area. The high percentage of loggerheads is likely due to several factors including their tendency to forage on the bottom where the dredge is operating and the fact that this species is the most numerous of the sea turtle species in Northeast and Mid-Atlantic waters. It is likely that the documentation of only one green sea turtle entrainment in Virginia dredging operations is a reflection of the low numbers of green sea turtles that occur in waters north of North Carolina. The low number of green sea turtles in the action area makes an interaction with a green sea turtle extremely unlikely to occur.

Volume dredged during sea turtle presence

Initial beach nourishment

The ER project includes dredging of 804,000 CY for initial nourishment and the FIMP project includes dredging of 4,200,000 CY for initial nourishment. Thus, the two project will dredge a total volume of 5,004,000 CY for the initial beach nourishments. The dredging for the initial beach nourishment for both projects will occur from October to September. The exact months when this dredging will occur is not known at this time. Assuming a worst case scenario, the dredging for the initial beach nourishment for both projects will occur during the months of May through November when sea turtles are present.

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operating without a UXO screen (and do not have a calculated estimate of take based on the number of cubic yards dredged) were included, as these screens, are likely to preclude an observer from detecting entrained sea turtles or sea turtle parts and thus, do not accurately reflect observed entrainment in relation to the cubic yards of material removed.

[8] This is calculated by dividing the total number of CY of material removed (25,547,552) by the adjusted number of sea turtle entrainments (10). This results in 1 sea turtle per 2,554,755.2 CY removed in the NYOBA.

Renourishment

For the LB project, you will dredge 1,770,000 CY for renourishment which will occur from October through March in four-year cycles from 2024-2037. The dredging for FIMI has been completed. For ER, you will dredge 2,300,000 CY for renourishment which will occur from October through March in four-year cycles from 2027-2037. For the FIMP project, you will dredge 3,000,000 CY for renourishment from October through March in three-year cycles. Based on information in an email you sent to us on July 31, 2020, in response to an inquiry from us, dredging times in the fall/winter can vary due to weather/safety related issues but in general, dredging for re-nourishment will occur during all six months (from October one year through March the following year), i.e. you assume dredging to occur during the entire 6 month period.

Since we expect sea turtles to be present within the project area from May through November, each project's re-nourishment activities will expose sea turtles to dredges for only two months, i.e. October and November. To calculate the volume of sediment that will be dredged during sea turtle presence, we divided total volume dredged for renourishment of each project on six (6) months (total CY dredged/six months = total CY per month for each project). We then multiplied the monthly CY by two (2) to get the total CY dredged during the months of October and November (i.e. turtle presence) for each project. Based on this, we estimate that over the life of this biological opinion (until end of 2039), a totalof 2,356,667 CY of material will be dredged for renourishment of beaches when sea turtles are present (Table 25).

Total dredge during sea turtle presence

Adding both initial beach nourishment activities and re-nourishment activities as calculated above, an estimated total of 7,360,667 CY of material will be dredged when sea turtles are present.

Table 25. Calculated cubic yards (CY) of material that will be dredgded for beach nourishment while sea turtles are present within the NYBOA. During the initial beach nourishment sea turtles will be present in the area for seven of the 12 months. During the dredging for re-nourishment, sea turtles are expected to be present only during two months (October and November). Shaded area indicates the data used to calculate CY dredged for renourishment when turtles are present.

Project	Initial CY	Nourishment CY	# events	Re-Nourishment CY/month*	Turtle presence (months)	Total dredged^ for renourishment during turtle presence	Total** dredged when turtles are present
LB	-	1,770,000	3	98,334	2	590,000	590,000
FIMI	-	0	0	0	-	0	0
ER	804,000	2,300,000		127,778	2	766,667	1,570,667
FIMP	4,200,000	3,000,000	5	100,000	2	100,000,000	5,200,000
TOTAL	**5,004,000**	**7,070,000**	**-**	**326,111**	**2**	**2,356,667**	**7,360,667**

*Calculated as Nourishment CY/Times events/six months

^ Calculated as total renourishment over life time of BiOp divided on six months and multiplied by two months of turtle presence.

** Total CY dredged for nourishment during turtle presence + initial CY dredged

Number of Sea Turtles Entrained

Given that we anticipate one turtle take in hopper dredges for every 2,600,000 cubic yards of material dredged, we estimate that no more than three (3)[9] sea turtles, rounded up, are likely to be entrained during the dredging at the NYOBA from 2021-2037. We expect that nearly all of the sea turtles will be loggerheads and that the entrainment of a Kemp's ridley during a dredge cycle will be rare; however, as Kemp's ridleys have been documented in the action area and have been entrained in hopper dredges, it is likely that this species will interact with the dredge over the course of the project life. As explained above, approximately 91% of the sea turtles taken in dredges operating in the USACE North Atlantic Division have been loggerheads. Based on the ratio of sea turtle entrainment in the USACE NAD, no more than one (1) of the sea turtles are likely to be entrained in a hopper dredge will be a Kemp's ridley. Thus, because loggerhead sea turtles are most likely to be entrained and the number of sea turtles expected to be entrained are so few, we expect that all three will be loggerhead with the possibility that one may be a Kemp's ridely sea turtle but with the total not exceeding three (3) sea turtles. As noted above, interactions with green sea turtles are extremely rare and have never been reported. Therefore, we do not expect that the proposed action will result in the entrainment of a green sea turtle in a hopper dredge.

7.5.2.2 Entrainment in Hopper Dredges – Atlantic Sturgeon

Atlantic sturgeon are vulnerable to entrainment in hopper dredges. Entrainment is believed to occur primarily when the draghead is not in firm contact with the channel bottom, so the potential exists that sturgeon feeding or resting on or near the bottom may be vulnerable to entrainment. Additionally, the size and flow rates produced by the suction power of the dredge, the condition of the channel being dredged, and the method of operation of the dredge and draghead all relate to the potential of the dredge to entrain sturgeon (Reine *et al.* 2014). These parameters also govern the ability of the dredge to entrain other species of fish, sea turtles, and shellfish.

The risk of interactions is related to both the amount of time sturgeon spend on the bottom and the behavior the fish are engaged in (*i.e.*, whether the fish are overwintering, foraging, resting or migrating) as well as the intake velocity and swimming abilities of sturgeon in the area (Clarke 2011). Intake velocities at a typical large self-propelled hopper dredge are 11 feet per second. Exposure to the suction of the draghead intake is minimized by not turning on the suction until the draghead is properly seated on the bottom sediments and by maintaining contact between the draghead and the bottom.

A significant factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon is less likely due to the increased swimming performance and the relatively small size of the draghead opening.

9 A total of 7,360,667 CY dredge during turtle presence divided on 2,600,000 CY = 2.83 turtles entrained.

In general, entrainment of large mobile animals, such as sturgeon, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the movements of animals are restricted (*e.g.*, in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead.

Entrainment of sturgeon during hopper dredging operations in Federal navigation channels appears to be relatively rare. From 1990-2012, USACE documented 28 incidents of sturgeon entrainment on monitored hopper dredges (Appendix A). Of these, 20 were Atlantic sturgeon, five were shortnose, two were Gulf sturgeon, and the species of one entrained sturgeon was not determined. Since that report was generated, one Atlantic sturgeon was entrained in the Ambrose Channel, New York (October 2012; alive); one Atlantic sturgeon was entrained in the Delaware River in May 2013 (released alive); five sturgeon were entrained in the Delaware River by hopper dredges in 2014.; two sturgeon were entrained in 2017; and two Atlantic sturgeon and one shortnose sturgeon were entrained in 2018. In 2014, four of the entrainments occurred during maintenance of the 40’ Philadelphia to the Sea channel in areas that had not been deepened (May – dead juvenile Atlantic; August – dead adult Atlantic; September – dead juvenile Atlantic; October – dead juvenile Atlantic) and one of the five (November – live juvenile Atlantic) occurred during maintenance of the 45’ channel. In 2017, one entrainment occurred during maintenance of the Philadelphia to Trenton 40’ channel (July – dead adult shortnose) and the other during maintenance of the Philadelphia to the Sea 45’ channel (October – dead juvenile Atlantic). In 2018, one of three entrainments occurred during maintenance of the Philadelphia to Trenton 40’ channel (October – dead juvenile Atlantic) and the two other were entrained during maintenance of Philadelphia to Sea 45’ channel (November – dead juvenile Atlantic and dead adult shortnose). Additionally, part of a decomposed sturgeon was entrained in a hopper dredge in Delaware River in September 2013. With the exception of the adult Atlantic sturgeon entrained in August 2014[10], all recorded interactions with Atlantic sturgeon have been with juveniles or subadults (length <150 cm). Given the large size of Atlantic sturgeon adults (greater than 150cm) and the size of the openings on the dragheads used for this action (openings no greater than 4” x 4”), adult Atlantic sturgeon are unlikely to be vulnerable to entrainment.

According to ODESS, from 2015-2020, the USACE has documented a total of 35 confirmed incidences of entrainment or capture of sturgeon species on monitored hopper dredging projects. Of these, 34 were reported as Atlantic sturgeon and one was recorded as an unknown Acipenseridae species. Information on these interactions is presented in Table 26. Most of these interactions occurred within harbors. It is also unclear whether all hopper takes within the

[10] The draghead operating on August 31, 2014 in the Philadelphia to Trenton reach had 10” x 10” openings.

regions have been entered into ODESS. According to the Sea Bright Offshore Borrow Area biological opinion (dated March 7, 2014) (NMFS 2014), few records exist between hopper dredges and Atlantic sturgeon within offshore environments similar to the NYOBA (Table 27).

Table 26. USACE Atlantic Sturgeon Entrainment Records from Hopper Dredge Operations (2015-2020)(ODESS, last accessed April 30, 2020).

Project Location	**Corps Division/District**	**Month/Year of Operation**	**Cubic Yards Removed**	**Observed Entrainment**
Savannah Harbor	SAD/Wilmington	January 2020	695,624	2
Brunswick Harbor	SAD/Wilmington	January 2020	255,312	4
Kings Bay Entrance Channel	SAD/Jacksonville	January 2020	Unknown	1
Wilmington Harbor	SAD/Wilmington	March-April 2019	Unknown	1
Savannah Harbor	SAD/Savannah	January-February 2019	Unknown	2
Kings Bay Entrance Channel	SAD/Jacksonville	January-March 2019	Unknown	1
Mayport Harbor	SAD/Jacksonville	January-April 2019	Unknown	1
Charleston Entrance Harbor	SAD/Charleston	May 2018-April 2019	Unknown	4
Charleston Entrance Harbor	SAD/Charleston	March 2018-January 2019	Unknown	2
Kings Bay Entrance Channel	SAD/Jacksonville	January 2018-March 2019	Unknown	1
Brunswick Harbor	SAD/Savannah	December 2017-March 2018	1,493,641	6
Wilmington Harbor	SAD/Wilmington	March-April 2017	31,773	1
Kings Bay Entrance Channel	SAD/Jacksonville	January-March 2017	1,220,067	1
Brunswick Harbor	SAD/Savannah	January-March 2017	Unknown	1
Savannah Harbor	SAD/Savannah	December 2016 – January 2017	Unknown	1
Charleston Entrance Channel	SAD/Charleston	April 2016-February 2017	2,088,476	2
Kings Bay Entrance Channel	SAD/Jacksonville	February-March 2016	1,224,123	2
Savannah Harbor	SAD/Savannah	February-March 2015	Unknown	1
Brunswick Harbor	SAD/Savannah	January-February 2015	Unknown	1
			Total:	35

Table 27. Open Estuarine Channel Deepening projects in USACE NAD from 1998-2012 with recorded cubic yardage (taken from SBOBA biological opinion (dated March 7, 2014) (NMFS 2014)) and the number of observed Atlantic sturgeon entrainments.[11] *Records are based on sea turtle observer reports which record listed species entrained as well as all other organisms entrained during dredge operations.*

Project Location	Year of Operation	Cubic Yards Removed	Observed Entrainment
Ambrose Channel- Contact Area B*	2012	1,510,000	1
York Spit Channel, VA	2011	1,630,713	2
Cape Henry Channel, VA	2011	2,472,000	0
York Spit Channel, VA	2009	372,533	0
Sandy Hook Channel, NJ	2008	23,500	1
York Spit Channel, VA	2007	608,000	0
Atlantic Ocean Channel, VA	2006	1,118,749	0
Thimble Shoal Channel, VA	2006	300,000	0
Thimble Shoal Channel, VA	2004	139,200	0
VA Beach Hurricane Protection Project	2004	844,968	0
Thimble Shoal Channel, VA**	2003	1,828,312	0
Cape Henry Channel, VA***	2002	1,407,814	0
York Spit Channel, VA****	2002	911,406	0
East Rockaway Inlet, NY	2002	140,000	0
Cape Henry Channel, VA	2001	1,641,140	0
Thimble Shoald Channel, VA	2000	831,761	0
Cape Henry Channel, VA	2000	759,986	0
York Spit Channel, VA	1998	296,140	0
Cape Henry Channel, VA	1998	740,674	0
Thimble Shoal Channel, VA	1996	529,301	0
East Rockaway Inlet, NY	1996	2,685,000	0
Cape Henry Channel, VA	1995	485,885	0
East Rockaway Inlet, NY	1995	412,000	0
York Spit Channel, VA	1994	61,299	0
Cape Henry Channel, VA	1994	552,671	0
	Total:	22,303,052	4

*Observed entrainment of Atlantic sturgeon believed to be a result of a damaged UXO screen. Therefore, we assume that the risk of entrainment was the same as if the dreddged did not have a mounted UXO screen.
** Fourteen Atlantic sturgeon removed during pre-dredge trawl/relocation trawling (September and November, 2003).
*** One Atlantic sturgeon removed during pre-dredge trawl/relocation trawling on 10/26/02.
**** One Atlantic sturgeon removed during pre-dredge trawl/relocation trawling on

[11] Only dredges operating without a UXO screen were included, as these screens, are likely to preclude an observer from detecting entrained sturgeon or sturgeon parts and thus, may not accurately reflect observed entrainment in relation to the cubic yards of material removed.

11/02/02.

On September 16, 2012, you informed us that the anterior portion of an Atlantic sturgeon was found within the inflow screening of the hopper dredge operating within the Ambrose Channel-Contract B. The sturgeon part was moderately decomposed. It is believed that the animal had died by some other cause(s) and thus, was not attributed as an entrainment incident related to or as a result of the Ambrose Channel deepening, and thus, was not considered in the table above.

As some dredges have been operating with a UXO screen since 2006, we cannot discount the possibility that, so long as the screen was undamaged, unobservable interactions may have still occurred with Atlantic sturgeon. As a result, we strongly believe that UXO screens, in undamaged states, are likely to preclude an observer from detecting entrained sturgeon or sturgeon parts. Accordingly, it is not appropriate to use data from dredging operations in which a UXO screen was used in our assessment of Atlantic sturgeon entrainment. In the absence of sufficient information specific to the NYOBA that we can rely on to make our assessment, it is most appropriate to consider other projects that have been conducted in a comparable environment to that of the NYOBA (see Table 27). The most appropriate projects to consider were those in "offshore"/ nearshore (*i.e.*, within 10 miles off the U.S. Eastern coastline) environments or open estuarine environments. We did not consider riverine or enclosed to semi-enclosed bays or estuaries in our assessment as the environmental characteristics of these areas are not comparable to open estuarine or offshore environments. As such, the level of entrainment in these areas would not be comparable to the level of entrainment that may occur in the NYOBA.

As explained above, in the Greater Atlantic Region (Maine through Virginia), endangered species observers have been present on all hopper dredges operating between April 1 and November 30 since 1994. While the primary responsibility of observers is to document sea turtle interactions, observers document all biological material entrained in the dredges. As such, they record any observed interactions with sturgeon. Sturgeon interactions have routinely been reported to NMFS. Therefore, we expect that the "observed entrainment" numbers noted above are comprehensive and that any interactions with Atlantic sturgeon would be recorded. While observers have not operated on dredges working from December – March, in the Greater Atlantic Region dredging during this time of year is rare (due to weather conditions) and we do not anticipate that there are many undocumented interactions between Atlantic sturgeon and hopper dredges.

In general, entrainment of large mobile animals, such as sturgeon or sea turtles, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. It has also been suggested that the risk of entrainment is highest in areas where the movements of animals are restricted (*e.g.*, in river channels) where there is limited opportunity for animals to move away from the dredge. Because hopper dredging will occur in an offshore environment (*i.e.*, the NYOBA), the movements of Atlantic sturgeon will not be restricted and we anticipate that most Atlantic sturgeon will be able to avoid the dredge. In addition, the hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. As mentioned above, while the NYOBA borrowing site for ER has a known Atlantic sturgeon aggregation area, several studies offshore of New York and Long Island (Dunton 2014, Erickson *et al.* 2011, Ingram *et al.* 2019) as well as offshore of North Carolina (Laney *et al.* 2007) have also suggested that sturgeon in these offshore aggregation areas are unlikely to be stationary and are regularly moving. Information suggests that Atlantic sturgeon migrating in the marine environment do not move along the bottom, but move further up in the water column. If Atlantic sturgeon are up off the bottom while in offshore areas, such as the NYOBA, the potential for interactions with the dredge are further reduced. Based on this information, the likelihood of an interaction of an Atlantic sturgeon with a hopper dredge operating in the NYOBA is expected to be low.

However, because we know that entrainment is possible and that not all mobile animals will be able to escape from the dredge (as evidenced by past entrainment of sea turtles and sturgeon), we anticipate that entrainment is still possible and as such, effects of these interactions on Atlantic sturgeon must be assessed. As noted above, outside of rivers/harbors, only four Atlantic sturgeon have been observed entrained in a hopper dredge from 1994 to 2012 (Table 27). The low level of interactions may be due to the use of pre-trawl/dredge relocation trawling. Although no Atlantic sturgeon were entrained in some locations, they were documented in the area prior to dredging operations. Another explanation for the low levels of interactions may be that some interactions were not reported to NMFS; however, based on information that has been provided to NMFS and discussions with observers, under-reporting is likely to be very rare.

As noted above, based on what we know about Atlantic sturgeon behavior in environments comparable to the NYOBA, it is reasonable to consider that the risk of entrainment at this site is similar to that of sites located within open estuarine environments (*i.e.*, Table 27). Some of the areas considered in this analysis (Table 27) are closer to shore than the area being dredged with a hopper dredge in the NYOBA and may be more heavily used than this area. Thus, an estimate of interactions derived from this information is conservative; however, at this time, this is the best available information on the potential for interactions with Atlantic sturgeon.
Past experience calculating the likelihood of interactions between hopper dredges and other species (*i.e.*, sea turtles) indicates that there is a relationship between the number of animals entrained and the volume of material removed. The volume of material removed is correlated to the amount of time spent dredging but is a more accurate measure of effort because reports often provide the total days of a project but may not provide information on the actual hours of dredging vs. the number of hours steaming to the disposal site or in port for weather or other delays. Thus, we will use information available for all dredging projects that have been undertaken in open estuarine or offshore environments in the mid-Atlantic for which cubic yards of material removed are available to calculate the number of Atlantic sturgeon likely to be entrained during dredging operations (Table 27). Using this method, and using the dataset presented in Table 27, we have calculated an entrainment rate of one Atlantic sturgeon is likely to be injured or killed for approximately every 5,600,000 CY of material removed during hopper dredging operations undertaken at the NYOBA. This calculation is based on a number of assumptions including the following: that adult and subadult Atlantic sturgeon are evenly

distributed throughout the action area, that all hopper dredges will have the same entrainment rate, and that Atlantic sturgeon are equally likely to be encountered throughout the time period when dredging will occur. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of Atlantic sturgeon from past dredging operations, including dredging operations in the vicinity of the action area, it includes multiple projects over several years, and all of the projects have had observers present which we expect would have documented any entrainment of Atlantic sturgeon.

Based on the information outlined above, we anticipate that dredging at the NYOBA will result in entrainment in the hopper dredge of a total of three (3) Atlantic sturgeon (Table 28). Because we expect that adult Atlantic sturgeon are too large to be vulnerable to entrainment and given the size of other sturgeon that have been entrained in other hopper dredging operations, we expect that these sturgeon will be subadults.

There is evidence that some Atlantic sturgeon, particularly small subadults, could be entrained in the dredge and survive. However, as the extent of internal injuries and the likelihood of survival is unknown, and the size of the fish likely to be entrained is impossible to predict, it is reasonable to conclude that any Atlantic sturgeon entrained in the hopper dredge are likely to be killed.

Table 28. Total volume dredged (initial nourishment plus re-nourishment) at NYOBP over 19 years and estimated number of Atlantic sturgeon entrained in the hopper dredge.

Project Name	**Volume (CY) Dredged from 2021-2037**	**Atlantic Sturgeon Entrainment**
LB	1,770,000	0.3
ER	3,104,000	0.6
FIMP	7,200,000	1.3
Total	12,074,000	3*

* Rounded up to be conservative

We have considered the best available information to determine from which DPSs individuals that will be killed are likely to have originated. Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2%. The three Atlantic sturgeon expected to be killed by hopper dredge will most likely be of NYB DPS (NYB DPS ratio is 2.64) origin but it is possible that one could be from any other DPS. Therefore, we expect that Atlantic sturgeon take by hopper dredge could be three NYB DPS or two NYB DPS and one from any of the GOM, CB, Carolina, or SA DPS.

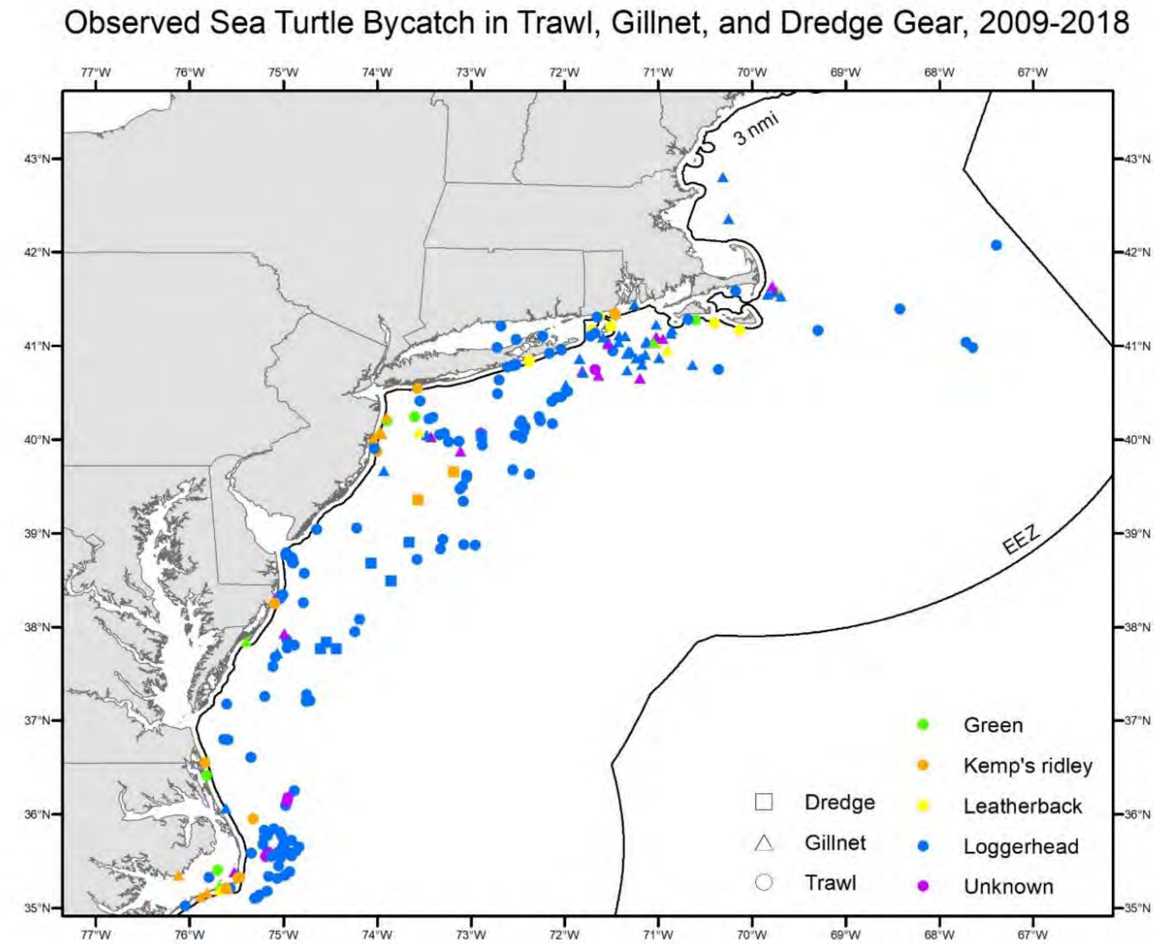
7.6 Aquatic Biological Monitoring Trawling

7.6.1 Trawling Gear Entrainment and Capture – Sea Turtles

The occurrence of loggerhead, Kemp's ridley, green, and leatherback sea turtles in New York waters is primarily temperature dependent (Braun-McNeill and Epperly 2004, James *et al.* 2005a, Morreale and Standora 2005, Morreale and Standora 1998, Musick and Limpus 1997, Shoop and Kenney 1992). In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas as water temperatures warm in the spring (Braun-McNeill and Epperly 2004, James *et al.* 2005a, Keinath *et al.* 1987, Mitchell *et al.* 2002, Morreale and Standora 2005, Morreale and Standora 1998, Musick and Limpus 1997, Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Braun-McNeill and Epperly 2004, James *et al.* 2005a, Keinath *et al.* 1987, Mitchell *et al.* 2002, Morreale and Standora 2005, Morreale and Standora 1998, Musick and Limpus 1997, Shoop and Kenney 1992). Great numbers of loggerheads, Kemp's ridleys, and greens are found in inshore, nearshore, and offshore waters of North Carolina, Virginia and New York from May through mid-November. The hard-shelled sea turtles (loggerheads, Kemp's ridleys, and greens) appear to be temperature limited to water no further north than Cape Cod. Leatherback sea turtles have a similar seasonal distribution but have a more extensive range in the Gulf of Maine compared to the hard-shelled species (Mitchell *et al.* 2002, Shoop and Kenney 1992).

Extensive survey effort of the continental shelf from Cape Hatteras to Nova Scotia, Canada in the 1980s (Winn *et al.* 1982) revealed that loggerheads were observed at the surface in waters from the beach to waters with bottom depths of up to 4,481 meters. However, they were generally found in waters where bottom depths ranged from 22-49 meters deep (the median value was 36.6 meters) (Shoop and Kenney 1992). Leatherbacks were sighted at the surface in waters with bottom depths ranging from 1-4,151 meters deep (Shoop and Kenney 1992). However, 84.4% of leatherback sightings occurred in waters where the bottom depth was less than 180 meters, whereas 84.5% of loggerhead sightings occurred in waters where the bottom depth was less than 80 meters (Shoop and Kenney 1992). Neither species was commonly found in waters over Georges Bank, regardless of season (Shoop and Kenney 1992). The Cetacean and Turtle Assessment Program (CeTAP) study did not include Kemp's ridley and green sea turtle sightings, given the difficulty of sighting these smaller sea turtle species (Winn *et al.* 1982).

Given the seasonal occurrence patterns and water depth preferences of sea turtles off the U.S. Atlantic coast from Florida to New England, the distribution of sea turtles is likely to overlap with the Aquatic Biological Monitoring program during the months of May through September. This is confirmed by the past capture of sea turtles in numerous commercial fisheries using similar gear types (trawls, gillnets, dredges) as evidenced by NEFOP incidental take data (Figure 26.



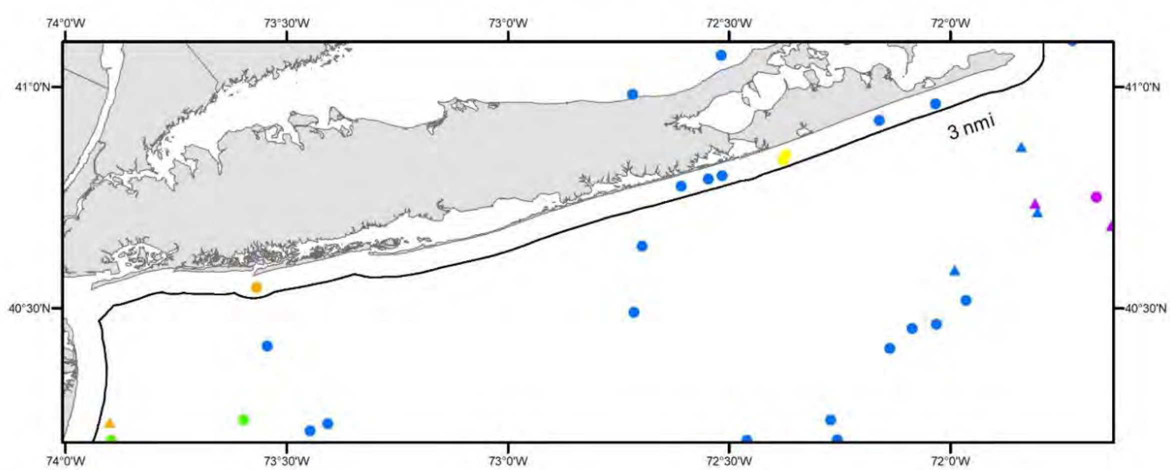


Figure 26. Observed Sea Turtle Bycatch in Trawl, Gillnet, and Dredge Gear from 2009-2018 as recorded in the NEFOP and At-Sea Monitoring Omnibus Data. The regional map is showing reported takes from January through December and the Long Island map is showing takes from June through October, plus one that occurred in December.

Background information on sea turtle interactions with bottom otter trawl gear
The potential for capture of sea turtles in bottom otter trawl gear is well established (Henwood and Stuntz 1987, Lutcavage and Lutz 1997, Lutcavage *et al.* 1997, Murray 2015b, 2020, NRC 1990). Sea turtles forcibly submerged in any type of restrictive gear can eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage and Lutz 1997, Lutcavage *et al.* 1997). A study examining the relationship between tow time and sea turtle mortality in the shrimp trawl fishery showed that mortality was strongly dependent on trawling duration, with the proportion of dead or comatose sea turtles rising from 0% for the first 50 minutes of capture to 70% after 90 minutes of capture (Henwood and Stuntz 1987).

Following the recommendations of the NRC to reexamine the association between tow times and sea turtle deaths, the data set used by Henwood and Stuntz (1987) was updated and re-analyzed (Epperly *et al.* 2002, Sasso and Epperly 2006). Seasonal differences in the likelihood of mortality for sea turtles caught in trawl gear were apparent. For example, the observed mortality exceeded 1% after 10 minutes of towing in the winter (defined as the months of December-February), while the observed mortality did not exceed 1% until after 50 minutes in the summer (defined as March-November) (Sasso and Epperly 2006). In general, tows of short duration (<10 minutes) in either season have little effect on the likelihood of mortality for sea turtles caught in the trawl gear and would likely achieve a negligible mortality rate (defined by the NRC as <1%). Longer tow times (up to 200 minutes in summer and up to 150 minutes in winter) result in a rapid escalation of mortality, and eventually reach a plateau of high mortality, but will not equal 100%, as a sea turtle caught within the last hour of a long tow will likely survive (Epperly *et al.* 2002, Sasso and Epperly 2006). However, in both seasons, a rapid escalation in the mortality rate did not occur until after 50 minutes (Sasso and Epperly 2006) as had been found by Henwood and Stuntz (1987). Although the data used in the NRC reanalysis were specific to bottom otter trawl gear in the U.S. south Atlantic and Gulf of Mexico shrimp fisheries, the authors considered the findings to be applicable to the impacts of forced submergence in general (Sasso and Epperly 2006).

Sea turtle behaviors may influence the likelihood of them being captured in bottom trawl gear. Video footage recorded by the NMFS, Southeast Fisheries Science Center (SEFSC), Pascagoula Laboratory indicated that sea turtles will keep swimming in front of an advancing shrimp trawl, rather than deviating to the side, until they become fatigued and are caught by the trawl or the trawl is hauled up (NMFS 2002). Sea turtles have also been observed to dive to the bottom and hunker down when alarmed by loud noise or gear (Memo to the File, L. Lankshear, December 4, 2007), which could place them in the path of bottom gear such as a bottom otter trawl. With respect to oceanographic features, a review of the data associated with the 11 sea turtles captured by the scallop dredge fishery in 2001 concluded that the sea turtles appeared to have been near the shelf/slope front (D. Mountain, pers. comm.).

There are very few reports of sea turtles dying during research trawls. Based on the analysis by Sasso and Epperly (2006) and Epperly *et al.* (2002) as well as information on captured sea turtles from past state trawl surveys, the NEAMAP and NEFSC bottom trawl surveys, as well as the

NEFSC FSB observer program, tow times less than 30 minutes will likely eliminate the risk of death from forced submergence for sea turtles caught in the bottom otter trawl survey gear.

During the spring and fall bottom trawl surveys conducted by the NEFSC from 1963-2019, a total of 91 loggerhead sea turtles were captured. Only one of the 91 loggerheads suffered injuries (cracks to the carapace) causing death. All others were alive and returned to the water unharmed. One leatherback and one Kemp’s ridley sea turtle have also been captured in the NEFSC bottom trawl surveys and each was released alive, although the Kemp's ridley had evidence of prior injuries. All 30 loggerhead, 32 Kemp’s ridley, and one green sea turtles captured in the NEAMAP bottom trawl surveys from 2007-2019, as well as all 15 loggerhead, seven Kemp's ridley, and three green sea turtles captured in the USFWS funded state bottom trawl surveys in the Northeast from 2013-2019, have been released alive and uninjured. The NEFSC, NEAMAP, and USFWS funded state bottom trawl survey tows are all approximately 20 minutes in duration. Studies for bottom trawl gear have begun to be funded in recent years. However, Swimmer *et al.* (2014) indicated that there are few reliable estimates of post-release mortality for sea turtles because of the many challenges and costs associated with tracking animals released at sea. Recently, the NMFS Northeast Sea Turtle Injury Workgroup reviewed the sea turtle interactions with trawls from 2013 to 2017 that were recorded by the NEFOP, At-Sea Monitoring, and interactions reported to the Sea Turtle Disentanglement Network. For that five year period, the resulting estimated mortality rate for observable intereactions in trawling gear was 48% (Upite *et al.* 2019). Parga *et al.* (2020) looked at the early occurrence of gaseous embolism and decompression sickness in marine turtles after incidental capture in trawl gear that was in the water for 184 to 302 minutes. Out of the 28 marine turtles that were examined on board the fishing vessels, 20 developed gaseuous embolism. Twelve of 28 (43%) animals died on-board, and three of 15 (20%) active turtles released with satellite tags died within six days (Parga *et al.* 2020). For now, we assume that post-release mortality for sea turtles in bottom otter trawl gear where tow times are short (10 minutes or less) is minimal to non-existent unless the turtle is already compromised to begin with. In that case, however, the animal would likely be retained onboard the vessel and transported to a rehabilitation center rather than released back into the water.

According to the 2009-2018 NEFOP and At-Sea Monitoring Omnibus data (Figure 26), five loggerhead, two leatherback, and one Kemp’s Ridley sea turtles were captured in trawling gear within the 3 nmi area south of Long Island during that 10 year period. Therefore, during the Aquatic Biological Monitoring program, we expect there will be the following number of non-lethal takes over the life of the program (Table 29). We do not expect any green sea turtles to be captured due to their rare occurrence in the action area. Because of the short tow times (10 minutes), we do not expect any takes to be lethal.

The risk of capture or entrainment of sturgeon by trawling gear utilized during the aquatic biological monitoring activity is small; yet, two subadult sturgeon (1.02 and 1.10 meters in length) were recently captured (July 2017) during monitoring activities at the Shinnecock Inlet to support construction of the project operations. Those sturgeon were captured, and released unharmed, during the month of July near Westhampton, NY during one monitoring season. Borrow area monitoring operations have been ongoing, periodically, for decades (on an 'as needed' basis and per the direction of each individual project's NYSDEC WQC) and the 2017 takes were the first and only recorded interactions with sturgeon during these biological monitoring activities.

Subadult and adult Atlantic sturgeon may be present in the action area year-round. In the marine environment, Atlantic sturgeon are most often captured in depths less than 50 meters. Some information suggests that captures in otter trawl gear are most likely to occur in waters with depths less than 40 meters and mesh sizes greater than 10 inches for sink gillnet gear (ASMFC 2007).

The analysis of potential future takes uses catch rates from these surveys (fish caught per trawl) and the number of annual bottom trawls in the different surveys to estimate future takes. Because of the great diversity of potential locations, timing, and protocols for future short-term monitoring projects, factors that could affect catch rates, data from the previous surveys was used to approximate catch rates for these types of monitoring projects.

Given the past capture of Atlantic sturgeon during the Aquatic Biological Monitoring program in trawl gear, it is reasonable to anticipate that Atlantic sturgeon will be present throughout some parts of the action area during the proposed trawling activities. As described above, we expect that Atlantic sturgeon in the action area will originate from the NY Bight, South Atlantic, Chesapeake Bay, Gulf of Maine, and Carolina DPSs. It is possible that a small fraction of Atlantic sturgeon in the action area may be Canadian origin (from the St. John River). The NYOBA area for the ER (Figure 1) is the only monitoring site that will be near the sturgeon aggregation site (Figure 24). Biological sampling for LB and FIMP and is expected to occur from September 2020 to the end of 2039, from September 2020 to the end of 2022 for FIMI, and from 2022 to the end of 2039 for the ER. Trawling will occur at each site for two days a month from April to September of any year. For the ER, there will be no sampling from April 7 through May 25.

The capture of Atlantic sturgeon in otter trawls used for commercial fisheries is well documented (ASMFC 2007, Stein *et al.* 2004a). Atlantic sturgeon are also captured incidentally in trawls used for scientific studies. To determine how many Atlantic sturgeon captures could occur from the Aquatic Biological Monitoring trawling, the results from the Dunton *et al.* (2015) study were used. Stratified bottom trawl random surveys that did not target Atlantic sturgeon as well as surveys that did target Atlantic sturgeon in the aggregation site were used to identify the sturgeon use of the New York waters south of Long Island. Because the District is not targeting Atlantic sturgeon in their Aquatic Biological Monitoriting Program, and they will only be sampling two days a month from April to September of each year at various sites of the NYOBA along the south coast of Long Island, the results of the stratified random surveys were used.

The depth-stratified random survey from Dunton *et al.* (2015) covered the waters inshore of 30 meters from the easternmost point of Long Island to the entrance of New York Harbor. Tows were 20 minutes in duration while traveling from 3-3.5 knots during the months of January through November. The survey showed that the weighted survey average Catch Per Unit Effort (CPUE) was 0.023 sturgeon/minute (Dunton *et al.* 2015).

Using the CPUE from Dunton *et al.* (2015), the 10 minute trawls from the Aquatic Biological Montintoring Program could capture 0.23 sturgeon per trawl. Given that the program has done an average of 120 trawls per season per site, and there are four sites to consider that are operating during certain years, there could be up to 7,320 trawls and up to 1,684 Atlantic sturgeon could be captured during the entire trawling program from 2020-2039 (Table 30). This is a very conservative estimate given that the study from Dunton *et al.* (2015) used longer tow times (a 10 minute difference) during January through November, and they sampled more frequently than two days per month.

The Atlantic sturgeon caught would be expected to be released alive and in good condition based on past experience. Given the continued use of fishing gears that have caused mortality of Atlantic sturgeon in commercial fisheries, and since some cooperative research projects may include research protocols similar to commercial fishing conditions, there is a potential for the Aquatic Biological Monitoring program to cause mortality in the future. However, given the substantially shorter tow times and other differences between most research and commercial fishing, such incidents would likely be rare.

The shorter tow durations (10 minutes) and careful handling of any sturgeon once on deck during research surveys is likely to result in an even lower potential for mortality, as commercial fishing trawls tend to be significantly longer in duration. None of the hundreds of Atlantic and shortnose sturgeon captured in past state ocean, estuary, and inshore trawl surveys have had any evidence of serious injury and there have been no recorded mortalities. Both the NEFSC and

NEAMAP surveys have recorded the capture of hundreds of Atlantic sturgeon since the inception of each. To date, there have been no recorded serious injuries or mortalities. In the Hudson River, a trawl survey that incidentally captures shortnose and Atlantic sturgeon has been ongoing since the late 1970s. To date, no serious injuries or mortalities of any sturgeon have been recorded in those surveys either. Based on this information, we expect that nearly all Atlantic sturgeon captured, regardless of DPS, during the proposed trawling will be alive and released uninjured.

Northeast Fisheries Observer Program data indicates that mortality rates of Atlantic sturgeon caught in otter trawl gear are approximately 5% (ASMFC 2007, Stein *et al.* 2004a). Thus, we anticipate that the proposed trawling will similarly result in a five percent (5%) mortality of the Atlantic sturgeon caught in the ABM trawl program from September 2020 through 2039. The Atlantic sturgeon could be from any DPS. Therefore, during the Aquatic Biological Monitoring program, we expect there will be the following number of non-lethal and lethal takes of Atlantic sturgeon over the life of the program (Table 30).

Table 30. Anticipated Number of Atlantic Sturgeon Trawling Interactions by Project.

Project	**Trawling Years**	**Number of Years**	**Estimated Number of Trawls (120/ season)**	**Esimated Number of Atlantic Sturgeon Takes (0.23 sturgeon/trawl)**
LB	2020-2039	20*	2,300	529
FIMI	2020-2022	3*	260	60
ER	2022-2039	18	2,160	497
FIMP	2020-2039	20*	2,300	529
		Total:	7,020	1,615

*For 2020, this biological opinion only covers trawling during September. Thus, this opinion only includes take that would occur during September 2020 or 20 trawls.

We have considered the best available information to determine from which DPSs individuals that will be killed are likely to have originated. Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2%. Based on our analysis above, we expect that up to five percent of the sturgeon from each DPS will be killed. Table 31 shows estimated number of Atlantic sturgeon mortality by DPS.

Table 31. Estimated number of Atlantic sturgeon caught including mortality (i.e. 5% of caught) by DPS as rounded numbers.

DPS	DPS Percentage	Caught	5% Mortality
GOM/Carolina	2	32	2
NYB	87	1,405	70
CB	8	129	7
SA	3	49	3
ALL DPS	**100**	**1,615**	**82**

7.7 Atlantic Sturgeon Tissue Sampling

Genetic samples may be taken from all captured fish. This will be done by taking a small (1 cm2) tissue sample, clipped with surgical scissors from a section of soft fin rays. This procedure does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Kahn and Mohead 2010). Many researchers have removed tissue samples according to this same protocol reporting no adverse effects (Wydoski and Emery 1983); therefore, we do not anticipate any short- or long-term adverse effects to the sturgeon from this activity.

8 CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR § 402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Sources of human-induced mortality, injury, and/or harassment of sea turtles and Atlantic sturgeon in the action area that are reasonably certain to occur in the future include interactions in state-regulated and recreational fishing activities, vessel collisions, ingestion of plastic debris, pollution, global climate change, coastal development, and catastrophic events. Actions carried out or regulated within the action area also include the regulation of dredged material discharges through CWA Section 401-certification and point and non-point source pollution through the National Pollutant Discharge Elimination System. We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects.[12] While the combination of these activities may affect sea turtles and Atlantic sturgeon, preventing or slowing a species' recovery, the full magnitude of these consequences is not completely known. However, we have considered the best information available in our assessment of both effects from the proposed action as well as cumulative effects.

[12] Cumulative effects are defined for NEPA as "the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

State Water Fisheries
Fishing activities are considered one of the most significant causes of death and serious injury for sea turtles. Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S.fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). Fishing gear in state waters, including bottom trawls, gillnets, trap/pot gear, and pound nets, interacts with sea turtles each year. NMFS is working with state agencies to address the bycatch of sea turtles in state water fisheries within the action area of this consultation where information exists to show that these fisheries capture sea turtles. Action has been taken by some states to reduce or remove the likelihood of sea turtle bycatch and/or the likelihood of serious injury or mortality in one or more gear types. However, given that state managed commercial and recreational fisheries along the U.S. Atlantic coast are reasonably certain to occur within the action area in the foreseeable future, additional interactions of sea turtles with these fisheries are anticipated. There is insufficient information to quantify the number of sea turtle interactions with state water fisheries as well as the number of sea turtles injured or killed as a result of these interactions. While actions have been taken to reduce sea turtle bycatch in some state water fisheries, the overall effect of these actions is not fully known, and the future effects of state water fisheries on sea turtles are presently difficult to quantify due to data and monitoring limitations. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the Status of the Species and Environmental Baseline sections.

Information on interactions with Atlantic sturgeon with state fisheries operating in the action area is not available, and it is not clear to what extent these future activities will affect listed species differently than the current activities described in the Status of the Species/Environmental Baseline section. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the Status of the Species/Environmental Baseline sections.

Vessel Interactions
NMFS's STSSN data indicate that vessel interactions are responsible for a number of sea turtle strandings within the action area each year. In the U.S. Atlantic from 1997-2005, 14.9% of all stranded loggerheads were documented as having sustained some type of propeller or collision injuries (NMFS and USFWS 2007). The incidence of propeller wounds rose from approximately 10% in the late 1980s to a record high of 20.5% in 2004 (STSSN database). Such collisions are reasonably certain to continue into the future. Collisions with boats can stun, injure, or kill sea turtles, and many live-captured and stranded sea turtles have obvious propeller or collision marks (Dwyer *et al.* 2003). However, it is not always clear whether the collision occurred pre-or post-mortem. NMFS believes that vessel interactions with sea turtles will continue in the future. An

estimate of the number of sea turtles that will likely be killed by vessels is not available at this time. Similarly, we are unable at this time to assess the risk that vessel operations in the action area pose to Atlantic sturgeon. While vessel strikes have been documented in several rivers, the extent that interactions occur in the marine environment is not fully known. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the Status of the Species and Environmental Baseline sections.

Pollution and Contaminants
Human activities in the action area causing pollution are reasonably certain to continue in the future, as are impacts from them on sea turtles and Atlantic sturgeon. However, the level of impacts cannot be projected. Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contamination may have effects on listed species' reproduction and survival. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle or sturgeon foraging ability. Marine debris (*e.g.*, discarded fishing line or lines from boats, plastics) also has the potential to entangle ESA-listed species in the water or to be fed upon by them. Sea turtles commonly ingest plastic or mistake debris for food and sometimes this may lead to asphyxiation. This Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the anticipated trends described in the Status of the Species and Environmental Baseline sections.

State NPDES Permits
New York has been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. Permittees include municipalities for sewage treatment plants and other industrial users. New York will continue to authorize the discharge of pollutants through these state issued permits. State standards are ultimately devised using EPA's techniques, which we anticipate to be insignificant and/or discountable to all listed species, so effects of discharges should also be. This Opinion assumes that effects in the future will be similar to those in the past and are, therefore, reflected in the anticipated trends described in the status of the Species/Environmental Baseline section.

Global Climate Change
In the future, global climate change is expected to continue and may impact listed species and their habitat in the action area. However, as noted in the Status of the Species and Environmental Baseline sections above, given the likely rate of change associated with climate impacts (*i.e.*, on a decadal to century scale), it is unlikely that climate related impacts will have a significant effect on the status of any listed species over the temporal scale of the proposed action (*i.e.*, over the next 19 years) or that in this time period, the abundance, distribution, or behavior of these species in the action area will significantly change as a result of climate change related impacts.

9 INTEGRATION & SYNTHESIS

In the effects analysis outlined above, we considered potential effects to sea turtles and Atlantic sturgeon from the following sources: (1) dredging at the NYOBA site with the cutterhead and hopper dredges; (2) beach nourishment at the LB, ER, and FIMP sites; (3) installation of bulkheads and groins; (4) physical alteration of the action area including consequences to benthic communities in the action area; and (5) aquatic biological monitoring sampling using trawls. In addition to these categories of effects, we considered the potential for collisions between listed species and project vessels. We anticipate the mortality of a small number of loggerhead and Kemp's ridley sea turtles, and Atlantic sturgeon from the five DPSs. Mortality of sea turtles will result from entrainment in hopper dredges operating at the NYOBA. Mortality of Atlantic sturgeon will occur from entrainment in the hopper dredge and biological monotoring trawling. As a result of the dredging, we anticipate mortality of as many as four loggerhead and one Kemp's ridley sea turtles. As a result of the dredging and biological monitoring operations, we anticipate mortality of as many as 88 Atlantic sturgeon. We do not anticipate any mortality of sea turtles or Atlantic sturgeon due to any of the other activities and their effects including vessel traffic, noise-producing work, or habitat removal.

In the discussion below, we consider whether the effects of the action as a whole reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the listed species that will be adversely affected by the action. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline – including take from completed activities, and cumulative effects, would jeopardize the continued existence of any listed species. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Below, for the listed species that may be affected by the proposed action, we summarize the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers, or distribution of these species and then consider whether any reductions in reproduction, numbers, or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the ESA.

9.1 North Atlantic DPS of green sea turtle

As noted in sections above, the physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of sea turtle prey in the affected areas, but these reductions will be localized and temporary, and foraging turtles are not likely to be limited by the reductions and any effects will be insignificant. Also, as explained above, no green sea turtles are likely to be entrained in any dredge or captured in the trawl and this species is not likely to be involved in any collision with a project vessel. As all possible effects to green sea turtles from the proposed project are likely to be insignificant or discountable, this action is not likely to adversely affect this species.

9.2 Leatherback sea turtles

We have estimated that the action under consideration in this opinion will result in the capture of up to 14 leatherback sea turtles during trawling activities from now and through 2039. We do not anticipate any serious injury or mortality. Some level of minor injury due to capture or release from the sampling gear may occur (*e.g.*, chips, cuts, or abrasions to the carapace or skin), but none would not rise to the level where it would cause a reduction in the species' numbers, reproduction, or distribution. All other consequences to leatherback sea turtles, including effects to prey, are expected to be insignificant or extremely unlikely.

Leatherback sea turtles are listed as "endangered" under the ESA. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS and USFWS 2013). Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed. There are some population estimates for leatherback sea turtles although there appears to be considerable uncertainty in the numbers. The most recent population size estimate for the North Atlantic alone is 34,000-94,000 adult leatherbacks (NMFS and USFWS 2013, TEWG 2007).

Leatherback nesting in the eastern Atlantic (*i.e.*, off Africa) and in the Caribbean appears to be stable, but there is conflicting information for some sites and it is certain that some nesting groups (*e.g.*, St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and USFWS 1995). Data collected for some nesting beaches in the western Atlantic, including leatherback nesting beaches in the U.S., clearly indicate increasing numbers of nests (NMFS and USFWS 2013, NMFS SEFSC 2001). However, declines in nesting have been noted for beaches in the western Caribbean (NMFS and USFWS 2013). The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to nest on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). The long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot *et al.* (2007) also suggest that the trend for the Suriname-French Guiana nesting population over the last several decades is stable or slightly increasing.

Increased nesting by leatherbacks in the Atlantic is not expected to affect leatherback abundance in the Pacific where the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 10 to 20 years (NMFS and USFWS 2013). Although genetic analyses suggest little difference between Atlantic and Pacific leatherbacks (Bowen and Karl 2007), it is generally recognized that there is little to no genetic exchange between these turtles.

There will be no serious injury or mortality to any individual leatherback sea turtle, and there will be no consequences to the prey base that would cause sea turtles to leave the action area. Therefore, the proposed action is not likely to reduce the numbers of leatherback sea turtles in the action area, or the numbers of leatherbacks in any subpopulation or the species as a whole. The proposed action will not affect the fitness of any individuals and we do not anticipate any consequences to reproduction. The action is also not likely to affect the distribution of leatherback sea turtles in the action area or affect the distribution of leatherback sea turtles throughout their range. Because consequences are limited to capture, with no serious injury or mortality, we do not anticipate any population level impacts. Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. While we are not able to predict with precision how climate change will continue to impact leatherback sea turtles in the action area or how the species will adapt to climate-change related environmental impacts, no additional consequences related to climate change to leatherback sea turtles in the action area are anticipated over the lifetime of the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above regarding potential reductions in numbers, reproduction, or distribution do not change.

Based on the information provided above, the non-lethal capture of up to 14 leatherback sea turtles will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of leatherback sea turtles; (2) there will be no effect to the fitness of any individuals and no consequenceson reproductive output of the species; (3) and, the action will have only a minor and temporary consequence on the distribution of leatherback sea turtles in the action area (related to the temporary capture and handling of captured individuals) and no effect on the distribution of the species throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the leatherback sea turtle species will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (*i.e.*, "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (*i.e.*, “threatened”) because of any of the following five listing factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence.

We do not expect the proposed action to modify, curtail or destroy the range of the species since it will not result in a reduction in the number of leatherback sea turtles and since it will not affect the overall distribution of the species other than to cause minor temporary adjustments in movements in the action area. The proposed action is not likely to result in any mortality or reductions in fitness or future reproductive output and therefore, the proposed action will not affect the persistence of the species. There will not be a change in the status or trend of the species. As there will be no reduction in numbers or future reproduction the action would not cause any reduction in the likelihood of improvement in the status of leatherback sea turtles. The effects consequences of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause any mortality or reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that leatherback sea turtles can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

9.3 Kemp’s ridley sea turtles

In the “Effects of the Action” section above, we determined that Kemp’s ridleys could be entrained in a hopper dredge when dredging the NYOBA. No interactions with Kemp’s ridleys have been recorded in dredging that has occurred to date. Based on a calculated entrainment rate of sea turtles for projects using hopper dredges in the action area, we estimate that one sea turtle is likely to be entrained for every 2.6 million CY of material removed with a hopper dredge. Also, based on the ratio of loggerhead and Kemp’s ridleys entrained in other hopper dredge operations in the USACE North Atlantic Division, we estimate that no more than 9 percent of the sea turtles entrained during project operations were likely to be Kemp’s ridleys with the remainder loggerheads. Based on this, we determined that up to three sea turtles are likely to be entrained during dredging (through 2039), with no more than one (1) being likely to be a Kemp’s ridley. We expect the one Kemp’s ridley sea turtle to be a juvenile, as adults rarely leave the Gulf of Mexico.

We have also estimated that the action under consideration in this opinion will result in the capture of up to seven Kemp’s ridley sea turtles during trawling activities until 2039. We do not anticipate any serious injury or mortality. Some level of minor injury due to capture or release from the sampling gear may occur (*e.g.*, chips, cuts, or abrasions to the carapace or skin), but none would not rise to the level where it would cause a reduction in the species’ numbers, reproduction, or distribution. All other consequencess to Kemp’s ridley sea turtles, including effects to prey, are expected to be insignificant or extremely unlikely.

Kemp's Ridley sea turtles are listed as a single species classified as "endangered" under the ESA. Kemp's ridleys occur in the Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963, NMFS and USFWS 2015, NMFS et al. 2011).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with the other sea turtle species discussed above, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females, and the age structure of the Kemp's ridley population, nest counts cannot be used to estimate the total population size (Hawkes *et al.* 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007, Meylan 1982, Ross 1996). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (TEWG 2000, USFWS and NMFS 1992). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 percent per year (TEWG 2000). Recent female population abundance for Kemp's ridleys, based on nests and hatchling recruitment, was estimated by Gallaway *et al.* (2013). They estimated the female population size for age-2 and older in 2012 to be 188,713 (SD = ±32,529). Assuming females comprise 76 percent (sex ratio = 0.76) (TEWG 1998, 2000) of the population, they estimated the total population of age 2 years and over at 248,307. Based on the number of hatchlings released in 2011 and 2012 (1+ million) and recognizing mortality over the first two years is high, Gallaway *et al.* (2013) thought the total population, including hatchlings younger than 2 years, may exceed 1 million turtles (NMFS and USFWS 2015).

The most recent five-year review of the Kemp's ridley suggests that the population growth rate (as measured by numbers of nests) stopped abruptly after 2009. Given the recent lower nest numbers, the population is not projected to grow at former rates. As a result, the status review team determined that the population is not recovering and cannot meet recovery goals unless survival rates improve (NMFS and USFWS 2015). However, some positive outlooks for the species include recent conservation actions (including the protection of females, nests, and hatchlings on nesting beaches since the 1960s) and the enhancement of survival in marine habitats through the implementation of TEDs in the early 1990s and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and USFWS 2015). There is also the recent record nesting year in Mexico and Texas for Kemp's ridleys in 2017.

The mortality of one Kemp's ridley over a 19-year time period represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females, the death of one Kemp's ridley represents approximately 0.0005 percent of the population. While the death of one Kemp's ridley will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species or its trend as this loss represents a very small percentage of the population (less than 0.0005 percent). Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals. A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction as any dead Kemp's ridleys would have no potential for future reproduction. Given the number of nesting adults, it is unlikely that the loss of one Kemp's ridley would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the dredging, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, and there are several thousand individuals in the population.

Based on the information provided above, the death of one Kemp's ridley sea turtle between now and 2039 will not appreciably reduce the likelihood of survival (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one Kemp's ridley represents an extremely small percentage of the species as a whole; (2) the death of one Kemp's ridley will not change the status or trends of the species as a whole; (3) the loss of this Kemp's ridley is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of this Kemp's ridley is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no consequence on the distribution of the species throughout its range; and, (6) the action will have no consequence on the ability of Kemp's ridleys to shelter and only an insignificant consequence on individual foraging Kemp's ridleys.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that Kemps ridley sea turtles will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, we issued a recovery plan for Kemp's ridleys (NMFS *et al.* 2011). The plan includes a list of criteria necessary for recovery. These include:

- An increase in the population size, specifically in relation to nesting females[13];
- An increase in the recruitment of hatchlings[14];
- An increase in the number of nests at the nesting beaches;
- Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,
- Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

Given the extremely small reduction in numbers, the loss of one Kemp's ridley during the proposed action (over 19 years) will not affect the population trend. The single Kemp's ridleys likely to die as a result of the proposed action is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the action will not affect the likelihood that criteria one, two, or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; therefore, the action will have no consequences on the likelihood that recovery criteria four will be met. All possible consequences to habitat will be extremely unlikely or insignificant; therefore, the proposed action will have no adverse consequences on the likelihood that criteria five will be met.

The consequences of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the action may result in a reduction in the number of

[13] A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur.

[14] Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

Kemp's ridleys by a single individual and a small reduction in the amount of potential reproduction (one individual over 19 years), these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to consequences related to the proposed action. We have considered the consequences of the proposed action in light of cumulative effects explained above and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one Kemp's ridley sea turtle between now and 2039, is not likely to appreciably reduce the survival and recovery of this species.

9.4 Northwest Atlantic DPS of loggerhead sea turtles

In the "Effects of the Action" section above, we determined that loggerheads could be entrained in a hopper dredge working in the NYOBA. No interactions with loggerhead sea turtles have been observed during dredging of this area to date. Based on a calculated entrainment rate of sea turtles for projects using hopper dredges in areas comparable to the NYOBA, we estimate that one sea turtle is likely to be entrained for every 2.6 million CY of material removed with a hopper dredge. Also, based on the ratio of loggerhead and Kemp's ridleys entrained in other hopper dredge operations in the USACE North Atlantic Division, we estimate that 91 percent of the sea turtles entrained during project operations were likely to be loggerheads. Based on this, we determined that up to three loggerhead sea turtles may be entrained during completed dredging (through 2039). All entrained loggersheads are expected to be juveniles.

We have estimated that the trawling activities under consideration in this opinion will result in the capture of up to 35 loggerhead sea turtles from now and until the end of 2039. We do not anticipate these captures to result in any serious injuries or mortalities. Some level of minor injury due to capture or release from the sampling gear may occur (*e.g.,* chips, cuts, or abrasions to the carapace or skin), but none would not rise to the level where it would cause a reduction in the species' numbers, reproduction, or distribution. All other consequences to loggerhead sea turtles, including consequences to prey, are expected to be insignificant or extremely unlikely.

The Northwest Atlantic (NWA) DPS of loggerhead sea turtles is listed as "threatened" under the ESA. It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the Status of the Species, Environmental Baseline and Cumulative Effects sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, dredging, power plant intakes and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, many remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but thesuccess of which cannot be quantified.

It is estimated that the number of adult females in the NWA DPS is at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS (NMFS SEFSC 2009). Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and USFWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats.

As stated above, we expect the lethal entrainment of three loggerheads over the 19-year time period during which dredging will occur; with an average mortality rate of approximately one loggerhead per six years. We would expect the lethal removal of up to three loggerhead sea turtles from the action area over this time period to reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed action (assuming all other variables remained the same). However, this does not necessarily mean that these recovery units will experience reductions in reproduction, numbers, or distribution in response to these econsequences to the extent that survival and recovery would be appreciably reduced. The final revised recovery plan for loggerheads compiled the most recent information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (*i.e.*, nesting groups). They are: (1) for the Northern Recovery Unit (NRU), a mean of 5,215 loggerhead nests per year with approximately 1,272 females nesting per year; (2) for the Peninsular Florida Recovery Unit (PFRU), a mean of 64,513 nests per year with approximately 15,735 females nesting per year; (3) for the Dry Tortugas Recovery Unit (DTRU), a mean of 246 nests per year with approximately 60 females nesting per year; and (4) for the Northern Gulf of Mexico Recovery Unit (NGMRU), a mean of 906 nests per year with approximately 221 females nesting per year. For the Greater Caribbean Recovery Unit (GCRU), the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit.

It is likely that the loggerhead sea turtles in the action area originate from several of the recovery units. Limited information is available on the genetic makeup of sea turtles in the mid-Atlantic, where the majority of sea turtle interactions are expected to occur. Cohorts from each of the five western Atlantic subpopulations are expected to occur in the action area. Genetic analysis of samples collected from immature loggerhead sea turtles captured in pound nets in the Pamlico-Albemarle Estuarine Complex in North Carolina from September-December of 1995-1997 indicated that cohorts from all five western Atlantic subpopulations were present (Bass *et al.* 2004). In a separate study, genetic analysis of samples collected from loggerhead sea turtles from Massachusetts to Florida found that all five western Atlantic loggerhead subpopulations were represented (Bowen *et al.* 2004). Bass *et al.* (2004) found that 80 percent of the juveniles and sub-adults utilizing the foraging habitat originated from the south Florida nesting population, 12 percent from the northern subpopulation, six percent from the Yucatan subpopulation, and two percent from other rookeries. The previously defined loggerhead subpopulations do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses both the south Florida and Florida panhandle subpopulations, the NRU is roughly equivalent to the northern nesting group, the Dry Tortugas subpopulation is equivalent to the DTRU, and the Yucatan subpopulation is included in the GCRU.

Based on the genetic analysis presented in Bass *et al.* (2004) and the small number of loggerheads from the DTRU or the NGMRU likely to occur in the action area it is extremely unlikely that the loggerheads likely to be killed during the dredging project will originate from either of these recovery units. The majority, at least 80 percent of the loggerheads killed, are likely to have originated from the PFRU, with the remainder from the NRU and GCRU. As such, of the three loggerheads likely to be killed, all three are expected to be from the PFRU, with the possibility that one of the three instead coming from either the NRU or the the GCRU. Below, we consider the effects of these mortalities on these three recovery units and the species as a whole.

As noted above, the most recent population estimates indicate that there are approximately 15,735 females nesting annually in the PFRU and approximately 1,272 females nesting per year in the NRU. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit; however, the 2008 recovery plan indicates that the Yucatan nesting aggregation has at least 1,000 nesting females annually. As the numbers outlined here are only for nesting females, the total number of loggerhead sea turtles in each recovery unit is likely significantly higher.

The loss of three loggerheads over a 19-year period represents an extremely small percentage of the number of sea turtles in the PFRU. Even if the total population was limited to 15,735 loggerheads, the loss of three individuals would represent approximately 0.019 percent of the population. Similarly, the loss of one loggerhead from the NRU represents an extremely small percentage of the recovery unit. Even if the total population was limited to 1,272 sea turtles, the loss of one individual would represent approximately 0.079 percent of the population. The loss of one loggerhead from the GCRU, which is expected to support at least 1,000 nesting females, represents less than 0.1 percent of the population. The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the species as a whole. The impact of these losses is even less when considering that these losses will occur over a span of 19 years. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the population as a whole.

All of the loggerheads that are expected to be killed will be juveniles. Thus, any effects on reproduction are limited to the loss of these individuals on their year class and the loss of future reproductive potential. Given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable trend of this species. Additionally, the proposed action will not affect nesting beaches or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede loggerheads from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction, and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerheads because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of loggerheads is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of up to three loggerheads between now and 2039 will not appreciably reduce the likelihood of survival (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect loggerheads in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is stabilizing; (2) the death of three loggerheads represents an extremely small percentage of the species as a whole; (3) the loss of these loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these loggerheads is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary consequence on the distribution of loggerheads in the action area and no consequence on the distribution of the species throughout its range; and, (6) the action will have no consequence on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that loggerhead sea turtles will survive in the wild. Here, we consider the potential for the proposed action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, we issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and USFWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

The loggerhead population has stabilized; as explained above, the loss of three loggerheads over 19 years as a result of the proposed action will not affect the population trend. The number of loggerheads likely to die as a result of the proposed action is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all consequences to habitat will be insignificant; therefore, the proposed action will have no adverse consequences on the likelihood that habitat based recovery criteria will be achieved. The proposed action will also not adversely affect the ability of any of the recovery tasks to be accomplished.

In summary, the effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the action may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that loggerhead sea turtles can be brought to the point at which they are no longer listed as threatened.

Despite the threats faced by individual loggerhead sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to consequences related to the proposed action. We have considered the consequences of the proposed action in light of other threats, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of the NWA DPS of loggerhead sea turtles.

9.5 Atlantic sturgeon

As explained above, the proposed action is likely to result in the mortality of a total of 85 Atlantic sturgeon from the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and/or South Atlantic DPSs through 2039 during the hopper dredging (3 sturgeon) and biological monitoring trawling (82 sturgeon) at the NYOBA. We expect that the Atlantic sturgeon killed could be subadults or adults. All other effects to Atlantic sturgeon, including consequences to habitat and prey due to dredging and beach nourishment and elevated underwater noise will be insignificant.

Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 87%; CB 8%; SA 3%; and GOM and Carolina (combined) 2%. Given these percentages, of the 82 sturgeon likely to be killed during the biological monitoring trawling operations, up to 70 will originate from the NYB DPS and up to 12 will originate from the GOM, CB, Carolina, and SA DPSs. The three Atlantic sturgeon expected to be killed by hopper dredge will most likely be of NYB DPS origin (NYB DPS ratio is 2.64) but it is possible that one could be from any other DPS. Therefore, we expect that Atlantic sturgeon take by hopper dredge could be three NYB DPS or a combination of two NYB DPS and one from any of the GOM, CB, Carolina, or SA DPS.Given the above, we estimate the following lethal take from each Atlantic sturgeon DPS:

DPS	Trawl Take	Dredge Take	Total***
GOM/Carolina	2	1*	3
NYB	70	3**	73
CB	7	1*	8
SA	3	1*	4

* One of three sturgeon taken in the dredge could be of any other DPS than the NYB DPS
** All three sturgeon taken in the dredge could be of NYB DPS origin.
*** The total take will not exceed 85 Atlantic sturgeon. The total column reflects the fact that the third lethal take from dredging may come from any other DPS than the NYB DPS and should be read as reflecting the uncertainty in

the attribution of the take to a DPS, not as an expectation that takes will occur in all non NYB DPSs. We anticipate only a single dredge take that could occur in any non NYB DPS.

9.5.1 Gulf of Maine and Carolina DPS

The GOM DPS is listed as threatened and the Carolina DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the GOM and Carolina DPSs, recent spawning has only been documented in the Kennebec and Androscoggin rivers in the GOM DPS and in the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers in the Carolina DPS. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.2.2, we have estimated a total of 7,455 GOM DPS adults and subadults (1,864 adults and 5,591 subadults) and a total of 1,356 Carolina DPS adults and subadults (339 adults and 1,017 subadults). This estimate is the best available at this time and represents only a percentage of the total GOM and Carolina DPS population as it does not include young-of-the-year or juveniles and does not include all adults and subadults. GOM and Carolina origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (*e.g.*, impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

We expect that the ABM trawling will result in the death of two Atlantic sturgeon of GOM DPS origin, two of Carolina DPS origin, or one of each origin. Atlantic sturgeon mortality in trawl could be either subadult or adult. In addition, we expect that dredging activities could kill one subadult Atlantic sturgeon of either GOM or Carolina DPS origin. This mortality will occur between now and the end of 2039. Thus, we expect that the Atlantic sturgeon mortalities may be three GOM DPS, three Carolina DPS, or a mix of GOM DPS and Carolina DPS not exceeding three total.

The number of adult and subadult GOM and Carolina DPS Atlantic sturgeon we expect to be killed due to the project (two between now and the end of 2039) represents an extremely small percentage of the GOM and Carolina DPSs. While the death of three GOM or Carolina DPS Atlantic sturgeon over this period will reduce the number of GOM or Carolina DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the GOM and Carolina DPS population of subadults and adults and an even smaller percentage of the overall DPSs as a whole. Even if there were only 7,455 adults and subadults in the GOM DPS, the loss would represent only 0.04 percent of the adults and subadults in the DPS, and if there were only 1,356 adults and subadults in the Carolina DPS, the loss would represent only 0.22 percent of the adults and subadults in the DPS. The percentage would be much less if we also considered the number of young-of-the-year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

Here, we consider the effects of the loss of up to three Atlantic sturgeon from September 2020 through 2039 from the GOM and/or Carolina DPS. The reproductive potential of the GOM and Carolina DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of three female individuals from now and through 2039, would have the effect of reducing the amount of potential reproduction as any dead GOM or Carolina DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the proposed action, any consequence to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of three male adult and/or subadults may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. The action will also not affect the spawning grounds within the rivers where GOM and Carolina DPS fish spawn.

The action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or trawling activities are underway, all of these changes in distribution will be temporary and limited to movements to nearby areas. We do not anticipate that any impacts to habitat will impact how GOM and Carolina DPS sturgeon use the action area.

Based on the information provided above, the death of no more than three GOM and/or Carolina DPS Atlantic sturgeon over the lifetime of this biological opinon, will not appreciably reduce the likelihood of survival of the GOM or Carolina DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM or Carolina DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging, and shelter. This is the case because: (1) the death of three GOM or Carolina DPS Atlantic sturgeon represents an extremely small percentage of the population of the DPSs; (2) the death of two GOM or Carolina DPS Atlantic sturgeon will not change the status or trends of the DPSs as a whole; (3) the loss of two GOM or Carolina DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of two GOM or Carolina DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the DPS; (5) the action will have only a minor and temporary consequence on the distribution of GOM or Carolina DPSs of Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (6) the action will have only an insignificant consequence on individual foraging, migrating, or sheltering GOM or Carolina DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the GOM and Carolina DPSs will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (threatened) is no longer warranted. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the GOM and Carolina DPSs can rebuild to a point where it is no longer in danger of becoming endangered within the foreseeable future throughout all or a significant portion of its range.

Recovery Plans for the GOM and Carolina DPSs have not yet been developed. The Recovery Plans will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend increasing population over time. To allow that to happen for GOM and Carolina Atlantic sturgeon DPSs, individuals must have access to enough habitat in suitable condition for foraging, migrating, resting, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this action will affect the GOM and Carolina DPSs likelihood of recovery.

This action will not change the status or trend of the GOM or Carolina DPS as a whole. The proposed action will result in a small amount of mortality and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trends in abundance of either species. This project will not affect spawning habitat of the GOM or Carolina DPS and will have only insignificant consequences to foraging habitat (in the Atlantic Ocean) used by GOM and Carolina DPSs of subadults and adults. We have determined that consequences to foraging habitat from loss of prey resulting from dredging are insignificant. Other impacts to habitat will be limited to temporary increases in suspended sediment during dredging and nourishment; however, as discussed in the Opinion, we do not anticipate any changes to substrate type. Once the dredging and beach nourishment are complete, we do not anticipate that any impacts to habitat will impact how sturgeon use the action area.

For these reasons, the action will not reduce the likelihood that the GOM and Carolina DPSs can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM and Carolina DPSs of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened and endangered, respectively. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.5.2 New York Bight DPS

The NYB DPS is listed as endangered. Based on the Mixed Stock Analysis, we expect that 87 percent of the subadult and adult Atlantic sturgeon in the action area will originate from the NYB DPS. NYB origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (*e.g.*, impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range. As discussed in section 4.2.2, we have estimated a total of 34,566 NYB DPS adults and subadults in the ocean (8,642 adults and 25,925 subadults). This estimate is the best available at this time and represents only a percentage of the total NYB DPS population as it does not include young-of-the-year or juveniles and does not include all adults and subadults. While there are some indications that the status of the NYB DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

We anticipate the mortality of up to 73 NYB DPS Atlantic sturgeon as a result of the hopper dredging and the Aquatic Biological Monitoring trawling. While it is possible that fish captured in the hopper dredge could survive, we assume here that these fish will be killed.

While NYB DPS Atlantic sturgeon occur in several rivers in the NYB DPS, spawning has until recently only been documented in the Hudson and Delaware rivers. The capture of age-0 Atlantic sturgeon in the Connecticut River indicates that spawning, at least in some years, is likely occurring in that river as well. No total population estimates are available for any river population or the DPS as a whole.

The overall ratio of Delaware River to Hudson River fish in the DPS as a whole is unknown. Some Delaware River fish have a unique genetic haplotype (the A5 haplotype); however, whether there is any evolutionary significance or fitness benefit provided by this genetic makeup is unknown. Genetic evidence indicates that while spawning continued to occur in the Delaware River and in some cases Delaware River origin fish can be distinguished genetically from Hudson River origin fish, there is free interchange between the two rivers. This relationship is recognized by the listing of the New York Bight DPS as a whole and not separate listings of a theoretical Hudson River DPS and Delaware River DPS. Thus, while we can consider the loss of Delaware River fish on the Delaware River population and the loss of Hudson River fish on the Hudson River population, it is more appropriate, because of the interchange of individuals between these two populations, to consider the effects of this mortality on the New York Bight DPS as a whole.

The estimated mortality of Atlantic sturgeon from the NYB DPS from all hopper dredging and trawling (73 subadult and/or adult) until 2039 represents a very small percentage of the population (considering the minimum population estimate of 34,566 NYB DPS adults and subadults, this represents 0.2 percent of the population; losses on an annual basis represent a substantially smaller percentage). While the death of these subadult and adult Atlantic sturgeon will reduce the number of NYB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the subadult and adult population and an even smaller percentage of the overall population of the DPS (early life stages, juveniles, subadults and adults combined).

The reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to 73 female sturgeon over from September 2020 through 2039 (average of 3.9 sturgeon per year) would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future female spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of a small percentage of up to 73 male Atlantic sturgeon may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year.

The proposed action will also not affect the spawning grounds within the rivers where NYB DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by NYB DPS fish. The proposed action is not likely to reduce distribution, because while sturgeon may temporarily avoid areas where dredging or trawling activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will permanently impact how sturgeon use the action area. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon.

Based on the information provided above, the death of up to 73 NYB DPS Atlantic sturgeon from now through 2039, will not appreciably reduce the likelihood of survival of the New York Bight DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed action will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging, and sheltering. This is the case because: (1) the death of these NYB DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of these NYB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these NYB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these NYB DPS Atlantic sturgeon will not result in the loss of any age class; (5) the loss of these NYB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; and (6) the action will have only a minor and temporary consequence on the distribution of NYB DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction throughout all or a significant part of its range.

A Recovery Plan for the NYB DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migrating, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the NYB DPS likelihood of recovery.

This action will not change the status or trend of the Hudson or Delaware River populations of Atlantic sturgeon or the status and trend of the NYB DPS as a whole. The proposed action will result in a small amount of mortality over the life of the project and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. We have determined consequences to habitat will be insignificant and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in a small amount of mortality and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the NYB DPS of Atlantic sturgeon. The action will not change the status or trend of the NYB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The consequences of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The consequences of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

9.5.3 Chesapeake Bay DPS

Individuals originating from the CB DPS are likely to occur in the action area. The CB DPS has been listed as endangered. We expect that eight percent of the subadult and adult Atlantic sturgeon in the action area will originate from the CB DPS. CB DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (*e.g.*, impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range.

Over the course of the dredging and trawling (through 2039), we anticipate the mortality of up to eight (8) CB DPS Atlantic sturgeon. These sturgeon could be killed due to entrainment in the hopper dredge or capture during the trawling. These fish could be CB DPS subadults or adults. While it is possible that entrained/captured fish could survive, we assume here that these fish will be killed.

While CB DPS Atlantic sturgeon occur in several rivers, recent spawning has only been documented in the James River and York River sytems. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.2.2, we have estimated a total of 8,811 CB DPS adults and subadults in the ocean (2,203 adults and 6,608 subadults). This estimate is the best available at this time and represents only a percentage of the total CB DPS population as it does not include young-of-the-year or juveniles and does not include all adults and subadults. CB origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

The eight CB DPS Atlantic sturgeon we expect to be killed due to the dredging and trawling from now through 2039 represents an extremely small percentage of the CB DPS. While the death of eight CB DPS Atlantic sturgeon through 2039 will reduce the number of CB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the CB DPS population of subadults and adults and an even smaller percentage of the DPS as a whole. If all eight mortalities were subadults and there were only 6,608 subadults in the CB DPS, this loss would represent only 0.1 percent of the subadults in the DPS. The percentage would be much less if we also considered the number of early life stages, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

The loss of eight female subadults and/or adults, would have the effect of reducing the amount of potential reproduction as any dead CB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any consequence to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of eight male subadults and/or adults, may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. Additionally, we have determined that for any sturgeon that are not killed, any impacts to behavior will be minor and temporary and there will not be any delay or disruption of movements to the spawning grounds or actual spawning. Further, the proposed action will also not affect the spawning grounds within the rivers where CB DPS fish spawn.

The action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or trawling activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how CB DPS sturgeon use the action area.

Based on the information provided above, the death of no more than eight CB DPS Atlantic sturgeon from now through 2039, will not appreciably reduce the likelihood of survival of the CB DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging, and sheltering. This is the case because: (1) the death of these CB DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of these CB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these CB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these CB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary consequence on the distribution of CB DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (6) the action will have only an insignificant effect on individual foraging, migrating, or sheltering CB DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for the CB DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, migrating, resting, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter, and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether these proposed action will affect the CB DPS likelihood of recovery.

This action will not change the status or trend of the CB DPS as a whole. The proposed action will result in a small amount of mortality from now through 2039 and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. This project will not affect spawning habitat of the CB DPS and will have only insignificant consequences on foraging habitat. We have determined that consequences to foraging habitat from loss of prey resulting from dredging are insignificant. Other impacts to habitat will be limited to temporary increases in suspended sediment during dredging. Once the dredging and renourishment are complete, we do not anticipate that any impacts to habitat will affect how sturgeon use the action area. For these reasons, the action will not reduce the likelihood that the CB DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.5.4 South Atlantic DPS

Individuals originating from the SA DPS are likely to occur in the action area. The SA DPS has been listed as endangered. We expect that three percent of subadult and adult Atlantic sturgeon in the action area will originate from the SA DPS. SA DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (*e.g.*, impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range.

Over the course of the remaining dredging and trawling (through 2039), we anticipate the mortality of up to four subadult and/or adult SA DPS Atlantic sturgeon. These sturgeon could be killed due to entrainment in a hopper dredge, or capture in a trawl. While it is possible that entrained/captured fish could survive, we assume here that these fish will be killed.

No total population estimates are available for any river population or the SA DPS as a whole. As discussed in section 4.2.2, we have estimated a total of 14,911 SA DPS adults and subadults in the ocean (3,728 adults and 11,183 subadults). This estimate is the best available at this time and represents only a percentage of the total SA DPS population as it does not include young-of-the-year or juveniles and does not include all adults and subadults. SA origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

The four SA DPS Atlantic sturgeon we expect to be killed due to the dredging and trawling represents an extremely small percentage of the SA DPS. While the death of four SA DPS Atlantic sturgeon from now through 2039 will reduce the number of SA DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the SA DPS population of subadults and adults and even a smaller percentage of the DPS as a whole. Even if there were only 11,183 subadults in the SA DPS, the loss of up to four would represent 0.04% of the subadults in the DPS. The percentage would be much less if we also considered the number of early life stages, young of the year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

The loss of four female subadults and/or adults would have the effect of reducing the amount of potential reproduction as any dead SA DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the four individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of male subadults and/or adults may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning. The proposed action will also not affect the spawning grounds within the rivers where SA DPS fish spawn.

The proposed action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or trawling activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how SA DPS sturgeon use the action area.

Based on the information provided above, the death of no more than four SA DPS Atlantic sturgeon from now through 2039, will not appreciably reduce the likelihood of survival of the SA DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging, and sheltering. This is the case because: (1) the death of these SA DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of these SA DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these SA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these subadult SA DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary consequence on the distribution of SA DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (6) the action will have only an insignificant consequence on individual foraging or sheltering SA DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that SA DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for the SA DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter, and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether these proposed action will affect the SA DPS likelihood of recovery.

This action will not change the status or trend of the SA DPS as a whole. The proposed action will result in a small amount of mortality from now through 2039 and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. This project will not affect the spawning habitat of the SA DPS and will have only insignificant consequences on foraging habitat. We have determined that consequences to foraging habitat from loss of prey resulting from dredging are insignificant. Other impacts to habitat will be limited to temporary increases in suspended sediment during dredging. Once the dredging and beach nourishment are complete, we do not anticipate that any impacts to habitat will affect how sturgeon use the action area. For these reasons, the action will not reduce the likelihood that the SA DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is our biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon, Kemp’s ridley, leatherback, and loggerhead sea turtles and is not likely to adversely affect green sea turtles or right or fin whales. Because no critical habitat is designated in the action area, none will be affected by the action.

11 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. “Fish and wildlife” is defined in the ESA “as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof.” 16 U.S.C. § 1532(8). “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. On December 21, 2016, we issued Interim Guidance on the Endangered Species Term "Harass." For use on an interim basis, we interpret "harass" to mean to "…create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. 1538(g). See also 16 U.S.C. § 1532(13) (definition of "person"). Under the terms of ESA section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not the purpose of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary, and must be undertaken by USACE so that they become binding conditions for the exemption in section 7(o)(2) to apply. USACE has a continuing duty to regulate the activity covered by this Incidental Take Statement. If USACE (1) fails to assume and implement the terms and conditions or (2) fails to require any contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to contracts or other documents as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, USACE must report the progress of the action and its impact on the species to us as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

11.1 Amount or Extent of Take

The proposed action have the potential to result in the mortality of loggerhead and Kemp's ridley sea turtles and individuals from the New York Bight, Gulf of Maine, Chesapeake Bay, Carolina and South Atlantic DPSs of Atlantic sturgeon due to entrainment in hopper dredges and trawling. These interactions are likely to cause injury and/or mortality to the affected sea turtles and sturgeon. This level of take is expected to occur over the entire period from now through 2039 and is not likely to jeopardize the continued existence of listed species.

This ITS exempts the following incidental take over the life span of the project:

Table 32. Exempted incidental take over the lifespan of the project.

Species	**Non-lethal**	**Lethal**
Northwest Atlantic DPS of loggerhead sea turtle	35 (trawling)	3 (hopper dredge entrainment)
Kemp's ridley sea turtle	7 (trawling)	1 (hopper dredge entrainment)
Leatherback sea turtle	14 (trawling)	0
Atlantic sturgeon	1,533 adults or subadults (trawling)	3 subadults (hopper dredge entrainment) 82 adults or subadults (trawling)

We expect the ABM trawling to result in up to 1,533 non-lethal and up to 82 lethal take of Atlantic sturgeon. In addition, we expect up to three (3) lethal take during dredging for a total lethal take of 85 Atlantic sturgeon. Lethal take during dredging may be of any of the folloing combinations: three from the NYB DPS or two from the NYB DPS and one from any of the other DPS.

Lethal take of Atlantic sturgeon by DPS:

- up to 73 from NYB DPS**
- up to 8 from CB DPS*
- up to 4 from SA DPS*
- up to 3 from GOM and/or Carolina DPS*

* One of three sturgeon taken in the dredge could be from any other DPS origin than the NYB DPS; accordingly, one lethal take is attributed to each of the non NYB DPSs, though only a single Atlantic sturgeon will be taken from one of the four non NYB DPSs

** All three sturgeon taken in the dredge could be of NYB DPS origin.

Non-lethal take of Atlantic sturgeon by DPS:

- 1,335 from NYB DPS
- 122 from CB DPS
- 46 from SA DPS
- 30 from GOM and/or Carolina DPS

When a hopper dredge is used, NMFS-approved endangered species observers are typically required on board the dredge to monitor for the entrainment of sea turtles and sturgeon. The endangered species observer program has been in place on hopper dredges since 1994 and is effective at monitoring take during hopper dredge operations. The use of observers relies on screening placed on the draghead being large enough to allow large sized pieces of biological material to pass through and be caught in cages that retain material that is then inspected by the observer. Once you reach the authorized number of sea turtles or Atlantic sturgeon takes provided in this Incidental Take Statement, any additional entrainment of a sea turtle or Atlantic sturgeon will exceed the exempted level of take and reinitiation is required.

11.2 Reasonable and Prudent Measures

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed action. In order to be exempt from prohibitions of section 9 of the ESA, you must comply with the following terms and conditions, which implement the reasonable and prudent measures described below and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging activities and trawling are taking place and will require you to report any take in a reasonable amount of time, as well as implement measures to monitor for entrainment during dredging and trawling. The third column below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by you.

In order to effectively monitor the effects of the proposed action, it is necessary to monitor the consequences of the action to document the amount of incidental take (*i.e.*, the number of sea turtles, and Atlantic sturgeon captured, injured, or killed) and to assess any sea turtles or sturgeon that are captured during this monitoring. In addition to ensuring compliance with this ITS and the assumptions in the underlying analysis of the biological opinion, monitoring provides information on the characteristics of sea turtles and sturgeon encountered and may provide data which will help develop more effective measures to avoid future interactions with ESA-listed species. We do not anticipate any additional injury or mortality to be caused by handling, assessing, and ultimately releasing sea turtles and sturgeon as required in the RPMs listed below.

Table 33. RPMs, TCs, and justifications applicable to the NY Coastal Storm Risk Management projects.

<u>RPMs applicable to all dredging activities at the New York Offshore Borrow Areas (NYOBA)</u>

Reasonable and Prudent Measures (RPMs)	**Terms and Conditions (TCs)**	**Justifications for RPMs & TCs**
1. We must be contacted prior to the commencement of dredging and again upon completion of the dredging activity.	1. You must contact us at incidental.take@noaa.gov three days before the commencement of each dredging activity and again within three days of the completion of the activity. This correspondence will serve both to alert us of the commencement and cessation of dredging activities and to give us an opportunity to provide you with any updated contact information or reporting forms. At the start of dredging activities, you must include the total volume and area you anticipate removing, the location/project name where dredging will occur and the type of dredge to be used. At the end of the dredging event, you must report to us the actual volume and area removed, location/project name where dredging occurred, and the equipment used (type of dredge).	These RPMs and TCs are necessary and appropriate because they serve to ensure that we are aware of the dates and locations of all dredging that may result in take. This will allow us to monitor the duration and seasonality of dredging activities as well as give us an opportunity to provide you with any updated species information or contact information for our staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve occasional e-mails between you and our staff.
2. All dredges must be operated in a manner that	2. If listed speciesare present during dredging or material transport, vessels transiting the area	These RPMs and TCs are necessary and appropriate as

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
will reduce the risk of interactions with listed species.	must post a bridge watch, avoid intentional approaches closer than 100 yards when in transit, and reduce speeds to below 4 knots if bridge watch identifies a listed species in the immediate vicinity of the dredge as determined by the line of sight from the vessel bridge.	they will require that dredge operators use best management practices, including slowing down to 4 knots should listed species be observed, that will minimize the likelihood of take. This represents only a minor change as following these procedures should not increase the cost of the dredging operation or result in any delays of reduction of efficiency of the dredging project.
3. All Atlantic sturgeon captured must have a fin clip taken for genetic analysis. This sample must be transferred to a NMFS-approved laboratory capable of performing the genetic analysis.	3. You must ensure that fin clips are taken (according to the "Procedure for Obtaining Sturgeon Fin Clips" document located at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic) of any Atlantic sturgeon captured during the project and that the fin clips are sent to a NMFS approved laboratory capable of performing genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole	These RPMs and TCs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	bodies. If only body parts are found and fins are not available, then take a sample of the tissue that is available. To the extent authorized by law, you are responsible for the cost of the genetic analysis.	level of incidental take associated with the proposed action. Genetic analysis must be conducted on Atlantic sturgeon samples to determine the appropriate DPS of origin and accurately record take of this species. These RPMs and TCs represent only a minor change as compliance will not result in delay of the project or decrease in the efficiency of the dredging operations.
4. Any dead sturgeon must be transferred to us or to an appropriately permitted research facility identified by us so that a necropsy can be undertaken to attempt to determine the cause of death. Sturgeon should be held in cold storage.	4. In the event of any lethal takes of Atlantic sturgeon, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with us.	These RPMs and TCs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
		level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations.
5. Any dead sea turtles must be held until proper disposal procedures can be discussed with us. Turtles should be held in cold storage.	5. In the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with us. If a decomposed turtle or turtle part is captured or entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are considered 'not fresh' (*i.e.*, they were obviously dead prior to the dredge take and you anticipate that they will not be counted towards the ITS) must be frozen and transported to a nearby stranding or rehabilitation facility for review. You must ensure that the observer submits the incident report for the decomposed turtle part, as well as	These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	photographs, to us within 24 hours of the take (see "Take Report Form" at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic) and request concurrence that this take should not be attributed to the Incidental Take Statement. We shall have the final say in determining if the take should count towards the Incidental Take Statement.	incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will only result in an extremely small increase in cost and will not delay the project, or decrease the efficiency of the dredging operations
6. All sturgeon captures, injuries, or mortalities in the immediate dredging area must be reported to us within 24 hours.	6. In the event of any captures or entrainment of Atlantic sturgeon (lethal or non-lethal), you must follow the "Sturgeon Take Standard Operating Procedures (SOPs)" found at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic) We shall have the final say in determining if the take should count towards the Incidental Take Statement. 7. If the cause of death is unknown (*e.g.*, dead sturgeon incidentally collected during dredging or trawlng in the Atlantic Ocean) NMFS will have the mortality assigned to the incidental take statement if a necropsy determines that the	These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	death was due to injuries sustained from an interaction with dredge gear.	monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not delay of the project or decrease in the efficiency of the dredging operations.
7. All sea turtle captures, injuries, or mortalities and any sea turtle sightings in the immediate dredging area must be reported to us within 12 hours.	8. In the event of any captures or entrainment of sea turtles (lethal or non-lethal), you must follow the "Sea Turtle Take Standard Operating Procedures (SOPs)" found at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic) We shall have the final say in determining if the take should count towards the Incidental Take Statement. 9. If the cause of death is unknown, dead sea turtles found along the coastline (e.g., beaches) within two weeks of when dredge operations occurred in the NYOBA and in an area where the carcass reasonably could	These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of incidental take associated

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	have drifted from dredge operations, will have the mortality assigned to the incidental take statement if a necropsy determines that the death was due to injuries sustained from an interaction with dredge gear. Sea turtle injuries consistent with hopper dredge interactions may include: - crushing wounds/injuries; - partial carapace or body part; - jagged edges to injury; - internal organs completely or partially missing or displaced; - excoriated skin injuries; or - peeling or missing scutes, not related to decomposition, around injury area	with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in delay of the project or decrease in the efficiency of the dredging operations
8. You shall ensure that all hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles.	10. All hopper dredges must be equipped with the rigid deflector draghead as designed by your Engineering Research and Development Center, formerly the Waterways Experimental Station (WES), or if that is unavailable, a rigid sea turtle deflector attached to the draghead. Deflectors must be checked and/or adjusted by a designated expert prior to a dredge operation to insure proper installation and operation during dredging. The deflector must be checked after every load throughout the dredge operation to ensure that proper	These RPMs and TCs are necessary and appropriate as the use of draghead deflectors is accepted standard practice for hopper dredges operating in places and at times of year when sea turtles are known to be present and has been documented to reduce the risk of entrainment for sea turtles, thereby minimizing the potential for take of these

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	installation is maintained. Since operator skill is important to the effectiveness of the WES-developed draghead, operators must be properly instructed in its use. Dredge inspectors must ensure that all measures to protect sea turtles are being followed during dredge operations.	species. This represents only a minor change as all of the hopper dredges likely to be used for this project already have draghead deflectors, dredge operators are already familiar with their use, and the use will not affect the efficiency of the dredging operation. Additionally, the current dredging is conducted with draghead deflectors in place.
9. For all hopper dredge operations, a NMFS-approved observer must be present on board the hopper dredge any time it is operating. You shall ensure that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that	11. You must ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Contracted observers shall have training that shall include measures discussed in the "Monitoring Specifications for Hopper and Mechanical Dredges" document located at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic.	These RPMs and TCs are necessary and appropriate because they require that you have sufficient observer coverage to ensure the detection of any interactions with listed species. This is necessary for the monitoring of the level of take associated with the proposed action. The inclusion of these RPMs and TCs is only a minor change as you included some

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
provides for handling, collection, and resuscitation of turtles injured during project activity. Full cooperation with the endangered/threatened species observer program is essential for compliance with the ITS.	12. Observer coverage on hopper dredges must be sufficient for 100% monitoring of hopper dredging operations. This monitoring coverage must involve the placement of a NMFS-approved observer on board the dredge for every day that dredging is occurring. You must ensure that your dredge operators and/or any dredge contractor adhere to the "Monitoring Specifications for Hopper and Mechanical Dredges" with trained NMFS-approved observers, in accordance with the attached "Observer Protocol" and "Observer Criteria" in the "Monitoring Specifications for Hopper and Mechanical Dredges" document. No observers can be deployed to the dredge site until you have written confirmation from us that they have met the qualifications to be a "NMFS-approved observer" as outlined in "Monitoring Specifications for Hopper and Mechanical Dredges" located at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. If substitute observers are required during dredging operations, you must ensure that our approval is obtained before those observers are deployed on dredges.	level of observer coverage in the original project description and the increase in coverage (*i.e.*, the addition of any months/activities that were not previously subject to observer coverage) will represent only a small increase in the cost of the project and will not result in any delays. These also represent only a minor change as in many instances the instructions and guidance serve to clarify the duties of the inspectors or observers.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	13. You shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. You shall also require that if it is necessary to clean the cage when the observer is off watch, any aquatic biological material is left in the cage for the observer to document and clear out when he/she returns on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen.	
10. You shall ensure that all measures are taken to protect any turtles or sturgeon that survive entrainment in a hopper dredge.	14. The procedures for handling live sea turtles must be followed in the unlikely event that a sea turtle survives entrainment in the dredge (see "Sea Turtle Handling and Transfer Instructions for Dredging Operations" document at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic). Any live sturgeon must be photographed, weighed and measured if possible, and released immediately overboard while the dredge is not operating. You must make arrangements with a NMFS-approved facility that agrees to receive any sea turtles injured during dredging. This arrangement must include procedures for transferring these turtles to the care of the	These RPMs and TCs are necessary and appropriate as they will require that dredge operators use best management practices that will minimize the likelihood of take. This represents only a minor change as following these procedures should not result in any delays of reduction of efficiency of the dredging project. Further, they are necessary and appropriate to ensure that any sea turtles or sturgeon that survive entrainment in a hopper dredge are given the maximum probability of

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	facility. To the extent authorized by law, arrangements must address funding of any necessary care and/or rehabilitation. This plan must be developed in cooperation with us and is subject to approval by us. This plan must be in place and approved before October 1, 2021.	remaining alive and not suffering additional injury or subsequent mortality through inappropriate handling. This represents only a minor change as following these procedures will not result in any delays to the proposed project.

RPMs Applicable to Aquatic Biological Monitoring Trawling

Reasonable and Prudent Measures (RPMs)	**Terms and Conditions (TCs)**	**Justifications for RPMs & TCs**
11. We must be contacted prior to the commencement of trawling and again upon completion of the trawling activity.	15. You must contact us at incidental.take@noaa.gov three days before the commencement of each trawling activity and again within three days of the completion of the activity. This correspondence will serve both to alert us of the commencement and cessation of trawling activities and to give us an opportunity to provide you with any updated contact information or reporting forms. At the start of trawling activities, you must include the the location/project name where trawling will occur and the number of tows anticipated. At the end of the trawling event, you must report to us the actual location/project name where trawling occurred, and the number of tows.	These RPMs and TCs are necessary and appropriate because they serve to ensure that we are aware of the dates and locations of all trawling that may result in take. This will allow us to monitor the duration and seasonality of trawling activities as well as give us an opportunity to provide you with any updated species information or contact information for our staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve occasional e-mails between you and our staff.
12. <u>PROTECTED SPECIES DISENTANGLEMENT TRAINING MATERIALS</u>: USACE must ensure that staff who intend to	16. USACE staff intending to disentangle sea turtles on their own must possess adequate sea turtle disentanglement training materials. Staff possessing adequate disentanglement training materials are authorized through this	This RPM and TC establishes the sea turtle disentanglement training materials that the biological monitoring staff must possess prior to

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
disentangle sea turtles from their gear possess adequate sea turtle disentanglement training materials provided by NMFS.	opinion to disentangle sea turtles according to the Northeast Atlantic Coast STDN Disentanglement Guidelines. USACE staff should contact the NMFS Greater Atlantic Region Sea Turtle Stranding and Disentanglement Coordinator (currently Kate Sampson; 978-282-8470) or the GARFO PRD Sea Turtle Program (978-281-9328) for information on required disentanglement protocols and equipment.	responding to the incidental take of sea turtles in fisheries research gear. These training materials will provide staff with adequate guidance in the handling, resuscitation, release, and reporting of sea turtles that may be incidentally captured over the course of the proposed action.
13. HANDLING AND RESUSCITATION: Any sea turtles or Atlantic sturgeon caught and retrieved in trawling activities covered under this opinion must be handled and resuscitated (if unresponsive) according to established protocols and whenever environmental conditions are safe for those handling and resuscitating the animal(s) to do so.	17. USACE must ensure that all staff have copies of the "Sea Turtle Handling & Resuscitation Measures" found at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. Monitoring staff must carry out these handling and resuscitation procedures any time a sea turtle is incidentally captured and brought onboard a vessel during the proposed action. If possible, it is requested that only trained or NMFS permitted staff perform the handling and resuscitation of captured sea turtles. 18. USACE must ensure that monitoring staff give priority to the handling and resuscitation of any sea turtles that are captured or entangled in fishing gear, if	RPM #13 and the accompanying Terms and Conditions establish the requirements for handling and resuscitating sea turtles and Atlantic sturgeon captured in research gear in order to avoid the likelihood of serious injury or mortality to these species from the hauling, handling, and emptying of the gear.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	environmental conditions are safe to do so. Handling times for sea turtles should be minimized (*i.e.*, kept to 15 minutes or less) to limit the amount of stress placed on the animals. 19. For sea turtles encountered during the proposed action that appear injured (*i.e.*, beyond minor chips, cuts, or abrasions to the carapace or skin), sick, distressed, or dead (including stranded or entangled individuals), monitoring staff must immediately contact their state's stranding and salvage network partner for further instructions and guidance on handling, retention, and/or disposal of the animal. If unable to contact the state's stranding and salvage organization, they must contact the Greater Atlantic Region Marine Animal Hotline at 866-755-NOAA (6622). If unable to contact either of the above (*e.g.*, due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 22A. If required, hard-shelled sea turtles (*i.e.*, non-leatherbacks) may be held onboard a vessel for up to 24 hours provided that conditions during holding are approved by the state's stranding and salvage organization or GARFO PRD and safe	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	handling practices are followed. Unless environmental conditions are unsafe, survey crews should make every effort to get an injured sea turtle to a rehabilitation facility. If the state or Federal stranding and salvage hotline or an available veterinarian cannot be contacted and the injured animal cannot be taken to a rehabilitation facility, fisheries survey staff must cease activities that could further stress the animal, allow it to rest and recuperate as conditions dictate, and then return the animal to the water. 20. Only trained fishery biologists may attempt to handle and resuscitate any incidentally taken Atlantic sturgeon. They should be aware of the NMFS guidelines for doing so, which are included on our website at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. If an entangled sturgeon is determined to be unresponsive or comatose, observers should attempt to resuscitate the fish by placing it in oxygenated water or providing a running source of water over the gills. Resuscitation should be attempted on all nonresponsive fish for at least 30 minutes. If the fish remains nonresponsive after 30 minutes, the fish should be	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	considered dead and the carcass reported to either GARFO PRD or a co-investigator, cooperating facility, or laboratory affiliated with the Sturgeon Salvage Network. In the event of a sturgeon mortality, also refer to the requirements in RPM #15 and T&C #26 below.	
14. DATA COLLECTION, SAMPLING, AND TAGGING: Any sea turtles or Atlantic sturgeon caught or retrieved in the ABM trawling covered under this opinion must be identified to species or species group and properly documented using appropriate materials and data collection forms provided by NMFS. Any Atlantic sturgeon captured in the trawl must have a fin clip taken for genetic analysis. This sample must be transferred to a NMFS-approved laboratory capable of performing genetic analysis for assignment of DPS.	21. USACE must ensure that monitoring staff are trained in the identification of sea turtles and Atlantic sturgeon. Although the NEFOP training manuals found at https://www.fisheries.noaa.gov/topic/fishery-observers#become-an-observer are the best source for species identification, we have also provided a general identification key on our website at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic to assist monitoring staff members. 22. USACE must ensure that all fisheries survey staff take or estimate measurements of and either photograph or video all sea turtles or Atlantic sturgeon incidentally captured in monitoring research gear. The condition of each animal and any visible or potential injuries must be documented to the best of the staff member's ability. Any external tagging information must also be recorded.	RPM # 14 and the accompanying Terms and Conditions specify the collection of information for any sea turtles or Atlantic sturgeon observed captured in ABM trawl gear. This is essential for monitoring the impacts of the proposed action and level of incidental take associated with them. Sampling of Atlantic sturgeon tissue is used for genetic sampling. The taking of fin clips for Atlantic sturgeon allows us to monitor take and assign take to a particular DPS. It allows you and us to determine if the actual level of take has been exceeded.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	These data must be entered into the "Take Reporting Form for ESA-Listed Species" provided on our website at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. 23. On all vessels where appropriate Passive Integrated Transponder (PIT) tag readers are available, captured sturgeon must be scanned for existing PIT tags. Any recorded sturgeon PIT tags must be reported to the U.S. FWS tagging database (POC: Mike Mangold at mike_mangold@fws.gov). 24. Any collection of Atlantic sturgeon fin clips of incidentally captured Atlantic sturgeon can only be performed by individuals trained in those activities. Fin clip sampling procedures for Atlantic sturgeon must be done in accordance with protocols on our website at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. Fin clips must be taken prior to preservation of other fish parts or whole bodies and must be sent to a NMFS approved laboratory capable of performing genetic analysis to determine what DPS the	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	fish belongs to. To the extent authorized by law, USACE or their state grantees are responsible for the cost of any genetic/DPS analyses.	
15. RELEASE OR RETENTION: Any live sea turtles or Atlantic sturgeon caught and retrieved in monitoring research gear covered under this opinion must ultimately be released according to guidance provided by the state's stranding response group, NMFS Marine Animal hotline, or established protocols and whenever environmental conditions are safe for those releasing the animal(s) to do so. Injured sea turtles should be transferred to an appropriately permitted facility identified by and at the suggestion of the state level stranding network partner or NMFS Marine Animal hotline. Any dead sea turtles or Atlantic	25. All live, non-seriously injured sea turtles and live Atlantic sturgeon that are incidentally captured in monitoring research gear must be released from the gear and back into the water as quickly as possible to minimize stress to the animal. All injured sea turtles (*i.e.*, beyond minor chips, cuts, or abrasions to the carapace or skin) should be reported to the state's stranding response group or NMFS Marine Animal hotline for further guidance on handling and transport, if necessary, to a rehabilitation facility. USACE must make arrangements with a NMFS-approved facility that agrees to receive any sea turtles injured during the proposed action. This arrangement must include procedures for transferring these turtles to the care of the facility. To the extent authorized by law, arrangements must address funding of any necessary care and/or rehabilitation. 26. In the event of any lethal takes of sea turtles, or Atlantic sturgeon, any dead specimens or body parts retained by or on behalf of individuals with NMFS issued permits	RPM #15 and the accompanying Terms and Conditions establish the requirements for releasing or retaining sea turtles and Atlantic sturgeon captured in fisheries research gear in order to provide live animals with the best chance for survival post-capture and to gather additional information on the cause of death of dead animals.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
sturgeon encountered during sampling must be retained, if logistically feasible and instructed by state stranding/salvage network partners or GARFO PRD to do so, and then transferred to an appropriately permitted research facility so that a necropsy can be undertaken. Sea turtle and Atlantic sturgeon carcasses should be held in cold storage until shipping or transfer.	should be preserved (frozen is preferred, although refrigerated is permitted if a freezer is not available) until retention or disposal procedures are discussed with the appropriate stranding and salvage network organization or GARFO PRD. In the event a permitted stranding or salvage network recipient is not available or the carcass is severely damaged or decayed to the point at which a necropsy would not be feasible, the animal should be disposed of at sea. It is up to the monitoring staff member to contact the state's stranding response group, or if not available, the Marine Animal hotline or Sturgeon Salvage Network partner for assistance in determining the state of damage/decay and to see whether a necropsy or salvage of the carcass is needed.	
16. <u>REPORTING</u>: GARFO PRD must be notified of all observed takes of sea turtles and Atlantic sturgeon resulting from monitoring research activities covered under this opinion.	27. In the event of any captures of sea turtles or Atlantic sturgeon (lethal or non-lethal), you must follow the species-specific Standard Operating Procedures (SOPs) found on our website at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic. 28. USACE must ensure that GARFO PRD is notified within 24 hours of any interaction	RPM #16 and the accompanying Terms and Conditions specify protocols for the reporting of information to GARFO PRD for any sea turtles and Atlantic sturgeon observed captured in monitoring research gear. This is essential for monitoring the level of incidental take

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	with a sea turtle or Atlantic sturgeon. These reports, included on our website at https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic, must be sent via e-mail to Incidental.take@noaa.gov (preferred) or called in to GARFO PRD. The report must include at a minimum: (1) reporter name and affiliation; (2) GPS coordinates (in decimal degrees or degrees/minutes/seconds) or a geographic description describing the specific location of the interaction; (3) portion and details of the gear involved (e.g., bottom trawl, gillnet, longline, pot/trap); (4) time and date of the interaction; and (5) identification of the animal to the species level. We also request the following information be provided: (1) a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes for sea turtles or mouth for sturgeon); (2) exact or estimated length/width of the animal; (3) ID numbers of external or internal tags recorded from; (4) condition of the animal upon retrieval and release/retention (*e.g.*, alive uninjured, alive potentially injured,	associated with the proposed action and ensuring that we can track any exceedance of the ITS.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (TCs)	Justifications for RPMs & TCs
	comatose or unresponsive, fresh dead, decomposed); and (5) a description of any care or handling provided. If reporting within 24 hours is not possible (*e.g.*, due to distance from shore or lack of ability to communicate via phone or email), the interaction must be reported as soon as the survey staff member is in a position to do so and absolutely no later than 24 hours after the vessel returns to port.	

12 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, NMFS recommends that the USACE consider the following Conservation Recommendations:

1. To the extent practicable, the USACE should avoid dredging during times of year when listed species are likely to be present.

2. To facilitate future management decisions on listed species occurring in the action area, the USACE should enter their data into ODESS to: a) create a history of use of the geographic areas affected; and, b) document endangered/threatened species presence/interactions with project operations.

3. The USACE should support ongoing and/or future research to determine the abundance and distribution of sea turtles and Atlantic sturgeon in New York waters.

4. The USACE should investigate, support, and/or develop additional technological solutions to further reduce the potential for sea turtle or Atlantic sturgeon takes in hopper dredges.

5. The USACE should consider devising and implementing some method of significant economic incentives to hopper dredge operators, such as financial reimbursement based on their satisfactory completion of dredging operations, or a certain number of cubic yards of material removed, or hours of dredging performed, *without taking turtles or sturgeon*. This may encourage dredging companies to research and develop "turtle or sturgeon friendly" dredging methods, more effective deflector dragheads, pre-deflectors, top-located water ports on dragarms, etc.

6. USACE should advise the Principal Investigators for all Aquatic Biological Monitoring to provide guidance, before each survey to the vessel crew members (including scientific crew and vessel operators) to the effect that: (a) all personnel are alert to the possible presence of ESA listed species in the study area, (b) care must be taken when emptying/retrieving sampling gear to avoid damage to sea turtles and sturgeon , and (c) survey gear should be emptied as quickly as possible after retrieval in order to determine whether sea turtles or sturgeon are present in the gear.

13 REINITIATION OF CONSULTATION

This concludes formal consultation on the USACE's beach nourishment projects utilizing the NYOBA and the Aquatic Biological Monitoring program. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation for the proposed action (i.e. all four projects) must be reinitiated immediately.

14 LITERATURE CITED

Anchor Environmental. 2003. Literature review of effects of resuspended sediments due to dredging operations. Anchor Environmental CA, L.P., Irvin, California. Dated June.

Andersson, M. H., E. Dock-Åkerman, R. Ubral-Hedenberg, M. C. Öhman, and P. Sigray. 2007. Swimming behavior of roach (*Rutilus rutilus*) and three-spined stickleback (*Gasterosteus aculeatus*) in response to wind power noise and single-tone frequencies. Ambio **36**(8): 636.

Armstrong, J. and J. Hightower. 2002. Potential for restoration of the Roanoke River population of Atlantic sturgeon. Journal of Applied Ichthyology **18**(4-6): 475-480.

ASMFC, (Atlantic States Marine Fisheries Commission). 1998a. Amendment 1 to the interstate fishery management plan for Atlantic sturgeon. Fishery Management Report No. 31.

ASMFC, (Atlantic States Marine Fisheries Commission). 1998b. Atlantic sturgeon stock assessment peer review report. Dated March 1998. NMFS Award No. NA87 FGO 025.

ASMFC, (Atlantic States Marine Fisheries Commission). 2007. Special Report to the ASMFC Atlantic Sturgeon Management Board: Estimation of Atlantic Sturgeon bycatch in coastal atlantic commercial fisheries of New England and the Mid-Atlantic. Dated August 2007.

ASMFC, (Atlantic States Marine Fisheries Commission). 2009. Atlantic sturgeon. *Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation and research needs*. Habitat Management Series 9: 195-253.

ASMFC, (Atlantic States Marine Fisheries Commission). 2010. 69th annual report of the Atlantic States Marine Fisheries Commission to the congress of the United States and to the governors and legislators of the fifteen compacting states. 68.

ASMFC, (Atlantic States Marine Fisheries Commission). 2017. Atlantic sturgeon benchmark stock assessment and peer review report, Arlington, Virginia. Dated October 18, 2017.

ASSRT, (Atlantic Sturgeon Status Review Team),. 2007. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). National Marine Fisheries Service, Northeast Regional Office, Gloucester, Massachusetts. Dated February 23.

Avens, L., J. C. Taylor, L. R. Goshe, T. T. Jones, and M. Hastings. 2009. Use of skeletochronological analysis to estimate the age of leatherback sea turtles Dermochelys coriacea in the western North Atlantic. Endangered Species Research **8**(3): 165-177.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: Common and divergent life history attributes. Environmental Biology of Fishes **48**(1): 347-358.

Bain, M. B., N. Haley, D. Peterson, J. R. Waldman, and K. Arend. 2000. Harvest and habitats of Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815 in the Hudson River estuary: Lessons for sturgeon conservation. Boletin Instituto Espanol de Oceanografia **16**(1-4): 43-53.

Balazik, M. T. 2018. Preliminary results of studies to determine sturgeon vessel strike risk and behavioral response to approaching vessels. [Personal Communication: Verbal] Recipient Johnsen, P.B., National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office Gloucester, Massachusetts. July 26, 2018.

Balazik, M. T. and G. C. Garman. 2018. Use of acoustic telemetry to document occurrence of Atlantic sturgeon within the inventory corridor for the Hampton Roads Crossing Study. A report to the Virginia Department of Transportation. Virginia Commonwealth University, Richmond, Virginia. Dated 20 June.

Balazik, M. T., G. C. Garman, M. L. Fine, C. H. Hager, and S. P. McIninch. 2010. Changes in age composition and growth characteristics of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) over 400 years. Biology Letters **6**(5): 708-710.

Balazik, M. T., G. C. Garman, J. P. Van Eenennaam, J. Mohler, and L. C. Woods. 2012a. Empirical evidence of fall spawning by Atlantic sturgeon in the James River, Virginia. Transactions of the American Fisheries Society **141**(6): 1465-1471.

Balazik, M. T., S. P. McIninch, G. C. Garman, and R. J. Latour. 2012b. Age and growth of Atlantic sturgeon in the James River, Virginia, 1997–2011. Transactions of the American Fisheries Society **141**(4): 1074-1080.

Balazik, M. T. and J. A. Musick. 2015. Dual annual spawning races in Atlantic sturgeon. PLoS ONE **10**(5): e0128234.

Balazik, M. T., K. J. Reine, A. J. Spells, C. A. Fredrickson, M. L. Fine, G. C. Garman, and S. P. McIninch. 2012c. The potential for vessel interactions with adult Atlantic sturgeon in the James River, Virginia. North American Journal of Fisheries Management **32**(6): 1062-1069.

Banks, G. E. and M. P. Alexander. 1994. Development and evaluation of a sea turtle-deflecting hopper dredge draghead. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi. Dated July. Miscellaneous Paper No. HL-94-5.

Barber, M. R. 2017. Effects of hydaulic dredging and vessel operation on Atlantic sturgeon behavior in a large coastal river. Unpublished M.Sc., Virginia Commonwealth University: Richmond, Virginia.

Bass, A. L., S. P. Epperly, and J. Braun-McNeill. 2004. Multi-year analysis of stock composition of a loggerhead turtle (*Caretta caretta*) foraging habitat using maximum likelihood and Bayesian methods. Conservation Genetics **5**(6): 783-796.

Benson, S. R., T. Eguchi, D. G. Foley, K. A. Forney, H. Bailey, C. Hitipeuw, B. P. Samber, R. F. Tapilatu, V. Rei, and P. Ramohia. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere **2**(7): 1-27.

Bigelow, H. B. and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin 74. United States Government Printing Office, Washington DC. DOI: https://doi.org/10.5962/bhl.title.6865.

Bjorndal, K. A. 1997. Foraging ecology and nutrition of sea turtles. In Lutz, P.L. and Musick, J.A. (Eds.), *The biology of sea turtles* (Volume I, pp. 199-231). CRC Press, Inc., Boca Raton, Florida.

Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2005. Evaluating trends in abundance of immature green turtles, Chelonia mydas, in the Greater Caribbean. Ecological Applications **15**(1): 304-314.

Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes **48**(1): 399-405.

Bowen, B. and J. Avise. 1990. Genetic structure of Atlantic and Gulf of Mexico populations of sea bass, menhaden, and sturgeon: influence of zoogeographic factors and life-history patterns. Marine Biology **107**(3): 371-381.

Bowen, B. W., A. L. Bass, S.-M. Chow, M. Bostrom, K. A. Bjorndal, A. B. Bolten, T. Okuyama, B. M. Bolker, S. Epperly, E. Lacasella, D. Shaver, M. Dodd, S. R. Hopkins- Murphy, J. A. Musick, M. Swingle, K. Rankin-Baransky, W. Teas, W. N. Witzell, and P. H. Dutton. 2004. Natal homing in juvenile loggerhead turtles (*Caretta caretta*). Molecular Ecology **13**(12): 3797-3808.

Bowen, B. W. and S. A. Karl. 2007. Population genetics and phylogeography of sea turtles. Molecular Ecology **16**(23): 4886-4907.

Boysen, K. A. and J. J. Hoover. 2009. Swimming performance of juvenile white sturgeon *(Acipenser transmontanus*): training and the probability of entrainment due to dredging. Journal of Applied Ichthyology **25**: 54-59.

Braun-McNeill, J. and S. P. Epperly. 2004. Spatial and temporal distribution of sea turtles in the western North Atlantic and the U.S. Gulf of Mexico from Marine Recreational Fishery Statistics Survey (MRFSS). Marine Fisheries Review **64**(4): 50-56.

Breece, M. W., D. A. Fox, K. J. Dunton, M. G. Frisk, A. Jordaan, and M. J. Oliver. 2016. Dynamic seascapes predict the marine occurrence of an endangered species: Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*. Methods in Ecology and Evolution **7**(6): 725-733.

Breece, M. W., D. A. Fox, D. E. Haulsee, I. I. Wirgin, and M. J. Oliver. 2017. Satellite driven distribution models of endangered Atlantic sturgeon occurrence in the mid-Atlantic Bight [online]. ICES Journal of Marine Science **NA**: fsx187-fsx187. DOI: 10.1093/icesjms/fsx187.

Breece, M. W., D. A. Fox, and M. J. Oliver. 2018. Environmental drivers of adult Atlantic sturgeon movement and residency in the Delaware Bay. **10**(2): 269-280.

Breece, M. W., M. J. Oliver, M. A. Cimino, and D. A. Fox. 2013. Shifting Distributions of Adult Atlantic Sturgeon Amidst Post-Industrialization and Future Impacts in the Delaware River: a Maximum Entropy Approach [online]. PLoS ONE **8**(11): e81321. DOI: 10.1371/journal.pone.0081321.

Brown, J. J. and G. W. Murphy. 2010. Atlantic sturgeon vessel-strike mortalities in the Delaware Estuary. Fisheries **35**(2): 72-83.

Brumm, H. and H. Slabbekoorn. 2005. Acoustic communication in noise. Advances in the Study of Behavior **35**: 151-209.

Brundage, H. M., III and J. O. O'Herron, II. 2009. Investigations of juvenile shortnose and Atlantic sturgeon in the Lower Tidal Delaware River. Bulletin New Jersey Academy of Science **52(**2): 1-8.

Burlas, M., G. Ray, and D. Clarke. 2001. The New York District's biological monitoring program for the Atlantic coast of New Jersey, Asbury Part to Manasquan section beach erosion control project. U.S. Army Engineer Research and Development Center, Waterways Experimental Station, Vicksburg, Mississippi.

Burton, W. H. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Versar, Inc., Columbia, Maryland. Dated June 1993. Prepared for Delaware Basin Fish and Wildlife Management Cooperative.

Bushnoe, T. M., J. A. Musick, and D. S. Ha. 2005. Essential Spawning and Nursery Habitat of Atlantic Sturgeon (*Acipenser oxyrinchus*) in Virginia. Essential fish habitat of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the southern Chesapeake Bay.

Caillouet, C. W., S. W. Raborn, D. J. Shaver, N. F. Putman, B. J. Gallaway, and K. L. Mansfield. 2018. Did declining carrying capacity for the Kemp's Ridley sea turtle population within the Gulf of Mexico contribute to the nesting setback in 2010− 2017? Chelonian Conservation and Biology **17**(1): 123-133.

Calvo, L., H. M. Brundage, D. Haidvogel, D. Kreeger, R. Thomas, J. C. O'Herron, II, and E. N. Powell. 2010. Effects of flow dynamics, salinity, and water quality on the Atlantic Sturgeon, the Shortnose Sturgeon and the Eastern Oyster in the Oligohaline Zone of the Delaware Estuary. Final report project year 2008-2009. Prepared for the U.S. Army Corps of Engineers, Philadelphia District. Seaboard Fisheries Institute, Bridgeton, New Jersey. Dated September 2010. Report No. 151265.

Caron, F., D. Hatin, and R. Fortin. 2002. Biological characteristics of adult Atlantic sturgeon (*Acipenser oxyrinchus*) in the St Lawrence River estuary and the effectiveness of management rules. Journal of Applied Ichthyology **18**(4-6): 580-585.

Carr, A. 1963. Panspecific Reproductive Convergence in Lepidochelys kempi. In Autrum, H., Bünning, E., v. Frisch, K., Hadorn, E., Kühn, A., Mayr, E., Pirson, A., Straub, J., Stubbe, H. and Weidel, W. (Eds.), *Orientierung der Tiere / Animal Orientation: Symposium in Garmisch-Partenkirchen 17.–21. 9. 1962* (pp. 298-303). Springer Berlin Heidelberg, Berlin, Heidelberg.

Chaloupka, M., K. A. Bjorndal, G. H. Balazs, A. B. Bolten, L. M. Ehrhart, C. J. Limpus, H. Suganuma, S. Troëng, and M. Yamaguchi. 2008. Encouraging outlook for recovery of a once severely exploited marine megaherbivore. Global Ecology and Biogeography **17**(2): 297-304.

Clarke, D. 2011. Sturgeon protection. (PowerPoint). Presented at the Dredged Material Assessment and Management Seminar, Jacksonville, Florida, 24-26 May, 2011.

ClimAID. 2011. Responding to climate change in New York State: Synthesis report. New York State Energy Research and Development Authority. 60 pp.

ClimAID. 2014. Climate change in New York State: updating the 2011 ClimAID climate risk information. New York State Energy Research and Development Authority (NYSERDA), Albany, New York.

Colette, B. and G. Klein-MacPhee. 2002. Bigelow and Schroeder's Fishes of the Gulf of Maine. Smithsonian Institution Press, Washington, DC.

Collins, M. R., S. G. Rogers, and T. I. J. Smith. 1996. Bycatch of Sturgeons along the Southern Atlantic Coast of the USA. North American Journal of Fisheries Management **16**(1): 24-29.

Collins, M. R. and T. I. J. Smith. 1997. Management Briefs: Distributions of Shortnose and Atlantic Sturgeons in South Carolina. North American Journal of Fisheries Management **17**(4): 995-1000.

Collins, M. R., T. I. J. Smith, W. C. Post, and O. Pashuk. 2000. Habitat utilization and biological characteristics of adult Atlantic sturgeon in two South Carolina Rivers. Transactions of the American Fisheries Society **129**(4): 982-988.

Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possaredt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite, and B. W. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service. Dated August 2009. Stock Assessment Report No. 38 000645.

Crance, J. Habitat suitability index curves for anadromous fishes. *In* Common Strategies of Anadromous and Catadromous Fishes, MJ Dadswell (ed.). Bethesda, Maryland, American Fisheries Society. Symposium, 1987 1: 554.
Dadswell, M. J. 2006. A review of the status of Atlantic sturgeon in Canada, with comparisons to populations in the United States and Europe. Fisheries **31**(5): 218-229.

Dadswell, M. J., B. D. Taubert, T. S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818. National Marine Fisheries Service, Silver Spring, Maryland. Dated October 1984. NOAA Technical Report NMFS No. 14 and FAO Fisheries Synopsis No. 140.

Damon-Randall, K., R. Bohl, S. Bolden, D. A. Fox, C. Hager, B. Hickson, E. Hilton, J. Mohler, E. Robbins, T. Savoy, and A. J. Spells. 2010. Atlantic Sturgeon research techniques. NOAA Technical Memorandum NMFS-NE-215: 64. National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusets.

Diaz, R. J., C. O. Tallent, and J. A. Nestlerode. 2006. Benthic resources and habitats at the Sandbridge borrow area: A test of monitoring protocols. Virginia Institute of Marine Science, Gloucester Point, Virginia. Dated March.

Doksæter, L., O. Rune Godø, N. Olav Handegard, P. H. Kvadsheim, F.-P. A. Lam, C. Donovan, and P. J. Miller. 2009. Behavioral responses of herring (*Clupea harengus*) to 1–2 and 6–7 kHz sonar signals and killer whale feeding sounds. The Journal of the Acoustical Society of America **125**(1): 554-564.

Dovel, W. L. and T. J. Berggren. 1983. Atlantic sturgeon of the Hudson estuary, New York. New York Fish and Game Journal **30**(2): 140-172.

Dredgepoint. Your Dredging Intelligence Network [Website]. Retrived, from https://www.dredgepoint.org/dredging-database/.

Dunton, K. J. 2014. Population dynamics of juvenile Atlantic Sturgeon, *Acipenser oxyrinchus oxyrinchus*, within the northwest Atlantic Ocean, The Graduate School, Stony Brook University: Stony Brook, NY.

Dunton, K. J., D. Chapman, A. Jordaan, K. Feldheim, S. J. O'Leary, K. A. McKown, and M. G. Frisk. 2012. Genetic mixed-stock analysis of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus* in a heavily exploited marine habitat indicates the need for routine genetic monitoring. J Fish Biol **80**(1): 207-217.

Dunton, K. J., A. Jordaan, D. O. Conover, K. A. McKown, L. A. Bonacci, and M. G. Frisk. 2015. Marine distribution and habitat use of Atlantic Sturgeon in New York lead to fisheries Interactions and bycatch. Marine and Coastal Fisheries **7**(1): 18-32.

Dunton, K. J., A. Jordaan, K. A. McKown, D. O. Conover, and M. G. Frisk. 2010. Abundance and distribution of Atlantic sturgeon (*Acipenser oxyrinchus*) within the Northwest Atlantic Ocean, determined from five fishery-independent surveys. Fishery Bulletin **108**(4): 450-465.

Dutton, P., V. Pease, and D. Shaver. Characterization of mtDNA variation among Kemp's ridleys nesting on Padre Island with reference to Rancho Nuevo genetic stock. *In* Twenty-Sixth Annual Conference on Sea Turtle Conservation and Biology, 2006: 189.
Dutton, P. H., B. W. Bowen, D. W. Owens, A. Barragan, and S. K. Davis. 1999. Global phylogeography of the leatherback turtle (*Dermochelys coriacea*). Journal of Zoology **248**(3): 397-409.

DWH NRDA (Deepwater Horizon Natural Resource Damage Assessment)Trustees. 2016. Deepwater Horizon oil spill: Final programmatic damage assessment and restoration plan and final programmatic Environmental Impact Statement. National Oceanographic and Atmospheric Administration. Dated February.

Dwyer, K., C. Ryder, and R. Prescott. Anthropogenic mortality of leatherback turtles in Massachusetts waters. *In* Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503, 2003: 260.
Eckert, K. L., B. P. Wallace, J. G. Frazier, S. A. Eckert, and P. C. H. Pritchard. 2012. Synopsis of the biological data on the leatherback sea turtle (*Dermochelys coriacea*). U.S. Fish and Wildlife Service, Washington, D.C. Biological Technical Publication BTP-R4015-2012.

Ehrhart, L. M., D. A. Bagley, and W. E. Redfoot. 2003. Loggerhead turtles in the Atlantic Ocean: geographic distribution, abundance, and population status. In Bolten, A.B. and Witherington, B.W. (Eds.), *Loggerhead Sea Turtles* (pp. 157-174). Smithsonian Institution Press, Washington, D.C.

EPA (Environmental Protection Agency). 1986. Quality Criteria for Water. Environmental Protection Agency, Office of Water Regulations and Standards, Washington D.C. Report No. 440/5-86-001.

EPA (Environmental Protection Agency). 2008. National coastal condition report III. (EPA/842-R-08-002): 329.

EPA CBP (Environmental Protection Agency Chesapeake Bay Program). 2010. 2010 State of the Chesapeake Bay program: Summary report to the Chesapeake Bay Executive Council. Dated June 3, 2010.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, and E. Scott-Denton. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast US waters and the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-490: 88. NMFS, Southeast Fisheries Science Center, Miami, Florida.

Erickson, D. L., A. Kahnle, M. J. Millard, E. A. Mora, M. Bryja, A. Higgs, J. Mohler, M. DuFour, G. Kenney, J. Sweka, and E. K. Pikitch. 2011. Use of pop-up satellite archival tags to identify oceanic-migratory patterns for adult Atlantic Sturgeon, *Acipenser oxyrinchus oxyrinchus* Mitchell, 1815. Journal of Applied Ichthyology **27**(2): 356-365.

Ernst, C. H. and R. Barbour. 1972. Turtles ofthe United States. University Press of Kentucky, Lexington. 347 pp.

Fernandes, S. J., G. B. Zydlewski, J. D. Zydlewski, G. S. Wippelhauser, and M. T. Kinnison. 2010. Seasonal distribution and movements of shortnose sturgeon and Atlantic sturgeon in the Penobscot River Estuary, Maine. Transactions of the American Fisheries Society **139**: 1436-1449.

Fernandez, I. J., C. Schmitt, E. Stancioff, S. D. Birkel, A. Pershing, J. Runge, G. L. Jacobson, and P. A. Mayewski. 2015. Maine's climate future: 2015 update. Climate Change Institute Faculty Scholarship: 26.

FHWA (Federal Highway Administration). 2012. Tappan Zee Hudson River crossing project: final environmental impact statement.

Figura, D. 2019. Researchers in awe: Huge, 14-foot Atlantic sturgeon spotted in Hudson River. *In* New York Upstate.

Finkbeiner, E. M., B. P. Wallace, J. E. Moore, R. L. Lewison, L. B. Crowder, and A. J. Read. 2011. Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 and 2007. Biological Conservation **144**(11): 2719-2727.

Fisher, M. 2009. Atlantic sturgeon final progress report. Period December 16, 2008 to December 15, 2009. Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control, 4876 Hay Point Landing Rd, Smyrna, Delaware 19977. Dated December 2009. Report No. T-4-1.

Fisher, M. 2011. Atlantic Sturgeon Final Report. Period October 1, 2006 to October 15, 2010. Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control, Smyrna, Delaware. Report No. T-4-1.

Fritts, M. W., C. Grunwald, I. Wirgin, T. L. King, and D. L. Peterson. 2016. Status and genetic character of Atlantic Sturgeon in the Satilla River, Georgia. Transactions of the American Fisheries Society **145**(1): 69-82.

Gallaway, B. J., C. W. Caillouet Jr, P. T. Plotkin, W. J. Gazey, J. G. Cole, and S. W. Raborn. 2013. Kemp’s ridley stock assessment project. Final Report to the Gulf States Marine Fisheries Commission.

Gilbert, C. R. 1989. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight)--Atlantic and shortnose sturgeons. Dated

December. U.S. Fish and Wildlife Service Biological Report No. 82(11.122). Report No. USACE TR EL-82-4.

Girondot, M., M. H. Godfrey, L. Ponge, and P. Rivalan. 2007. Modeling approaches to quantify leatherback nesting trends in French Guiana and Suriname. Chelonian Conservation and Biology **6**(1): 37-46.

Greene, C. H., A. J. Pershing, T. M. Cronin, and N. Ceci. 2008. Arctic climate change and its impacts on the ecology of the North Atlantic. Ecology **89**(sp11): S24-S38.

Greene, K. 2002. Beach nourishment: A review of the biological and physical impacts. Atlantic States Marine Fisheries Commission (ASMFC), 1444 Eye Street, NW, Sixth Floor, Washington, DC 20005. ASMFC Habitat Management Series 7. Report No. ASMFC and NOAA Award Number NA17FG2205.

Greene, K. E., J. L. Zimmerman, R. W. Laney, and J. C. Thomas-Blate. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. Atlantic States Marine Fisheries Commission Habitat Management Series. ASMFC, Washington, D.C.

Groombridge, B. 1982. Kemp's Ridley or Atlantic Ridley, *Lepidochelys kempii* (Garman 1880). The IUCN Amphibia, Reptilia Red Data Book: 201-208.

Grunwald, C., L. Maceda, J. Waldman, J. Stabile, and I. Wirgin. 2008. Conservation of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*: delineation of stock structure and distinct population segments. Conservation Genetics **9**(5): 1111-1124.

Guerra-García, J. M. and J. C. García-Gómez. 2006. Recolonization of defaunated sediments: Fine versus gross sand and dredging versus experimental trays. Estuarine, Coastal and Shelf Science **68**(1–2): 328-342.

Guilbard, F., J. Munro, P. Dumont, D. Hatin, and R. Fortin. 2007. Feeding ecology of Atlantic sturgeon and lake sturgeon co-occurring in the St. Lawrence estuarine transition zone. In Munro, J., Hatin, D., Hightower, J.E., McKown, K., Sulak, K.J., Kahnle, A.W. and Caron, F. (Eds.), *Anadromous sturgeons: habitats, threats, and management*. American Fisheries Society Symposium 56: 85-104. American Fisheries Society, Bethesda, Maryland.

Hager, C., J. Kahn, C. Watterson, J. Russo, and K. Hartman. 2014. Evidence of Atlantic Sturgeon Spawning in the York River System. Transactions of the American Fisheries Society **143**(5): 1217-1219.

Halvorsen, M. B., B. M. Casper, F. Matthews, T. J. Carlson, and A. N. Popper. 2012a. Effects of exposure to pile-driving sounds on the lake sturgeon, Nile tilapia and hogchoker. Proceedings of the Royal Society B: Biological Sciences **279**(1748): 4705-4714.

Halvorsen, M. B., B. M. Casper, C. M. Woodley, T. J. Carlson, and A. N. Popper. 2012b. Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds. PLoS ONE **7**(6): e38968.

Halvorsen, M. B., B. M. Casper, C. M. Woodley, and A. N. Popper. 2011. Predicting and mitigating hydroacoustic impacts on fish from pile installations. National Cooperative Highway Research Program, Transportation Research Board, National Academy of Science, Washington D.C. Dated October 2011. NCHRP Research Results Digest 368.

Hatin, D., R. Fortin, and F. Caron. 2002. Movements and aggregation areas of adult Atlantic sturgeon (*Acipenser oxyrinchus*) in the St Lawrence River estuary, Québec, Canada. Journal of Applied Ichthyology **18**(4-6): 586-594.

Hatin, D., J. Munro, F. Caron, and R. D. Simons. 2007. Movements, home range size, and habitat use and selection of early juvenile Atlantic Sturgeon in the St. Lawrence Estuarine Transition Zone. In Munro, J., Hatin, D., Hightower, J.E., McKown, K.A., Sulak, K.J., Kahnle, A.W. and Caron, F. (Eds.), *Anadromous Sturgeons: Habitats, Threats, and Management*. American Fisheries Society, Symposium 56: 129-155. American Fisheries Society, Bethesda, Maryland.

Hawkes, L. A., A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2005. Status of nesting loggerhead turtles *Caretta caretta* at Bald Head Island (North Carolina, USA) after 24 years of intensive monitoring and conservation. Oryx **39**(1): 65-72.

Hayes, D. F., T. R. Crockett, T. J. Ward, and D. Averett. 2000. Sediment resuspension during cutterhead dredging operations. Journal of Waterway, Port, Coastal, and Ocean Engineering **126**(3): 153-161.

Hays, G. C. 2000. The implications of variable remigration intervals for the assessment of population size in marine turtles. Journal of Theoretical Biology **206**(2): 221-227.

Henwood, T. A. and W. E. Stuntz. 1987. Analysis of sea turtle captures and mortalities during commercial shrimp trawling. Fishery Bulletin **85**(4): 813-817.

Heppell, S. S., D. T. Crouse, L. B. Crowder, S. P. Epperly, W. Gabriel, T. Henwood, R. Márquez, and N. B. Thompson. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles. Chelonian Conservation and Biology **4**(4): 767-773.

Hildebrand, S. F. and W. C. Schroeder. 1928. Fishes of chesapeake bay. 376.

Hilterman, M. L. and E. Goverse. 2004. Annual Report on the 2003 Leatherback Turtle Research and Monitoring Project in Suriname. World Wildlife Fund - Guianas Forests and Environmental Conservation Project (WWF-GFECP). Netherlands Committee for IUCN (NC-IUCN), Amsterdam, the Nederlands. Dated February 2004.

Hilton, E. J., B. Kynard, M. T. Balazik, A. Z. Horodysky, and C. B. Dillman. 2016. Review of the biology, fisheries, and conservation status of the Atlantic Sturgeon, (*Acipenser oxyrinchus oxyrinchus* Mitchill, 1815). Journal of Applied Ichthyology **32**(S1): 30-66.

Hirth, H. F. 1997. Synopsis of the biological data of the green turtle, *Chelonia mydas* (Linnaeus 1758). U.S. Department of Interior, Fish and Wildlife Service, Washington D.C., District of Columbia. Dated Nov 7, 1997. Biological Report 97 No. 1. Report No. 97 (1).

Holland, B. F., Jr. and G. F. Yelverton. 1973. Distribution and biological studies of anadromous fishes offshore North Carolina. North Carolina Department of Natural and Economic Resources, Division of Commercial and Sports Fisheries, Morehead City, North Carolina. Dated May 1973. Report No. 24.

Holton, J. W. and J. B. Walsh. 1995. Long-term dredged material management plan for the upper James River, Virginia. United States Army Corps of Engineers Norfolk District.

Horne, A. N. and C. P. Stence. 2016. Assessment of critical habitats for recovering the Chesapeake Bay Atlantic sturgeon distinct population segment. NOAA Species Recovery Grants to States (Section 6 Program) No. NA13NMF4720042.

Hulme, P. E. 2005. Adapting to climate change: is there scope for ecological management in the face of a global threat? Journal of Applied Ecology **42**(5): 784-794.

Ingram, E. C., R. M. Cerrato, K. J. Dunton, and M. G. Frisk. 2019. Endangered Atlantic sturgeon in the New York Wind Energy Area: implications of future development in an offshore wind energy site. Scientific reports **9**(1): 1-13.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom. 976 pp.

IPCC (Intergovernmental Panel on Climate Change). 2014. Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of working group II to the fifth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press Cambridge, United Kingdom and New York, NY. p. 1132.

James, M. C., C. Andrea Ottensmeyer, and R. A. Myers. 2005a. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecology Letters **8**(2): 195-201.

James, M. C., R. A. Myers, and C. A. Ottensmeyer. 2005b. Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. Proceedings of the Royal Society B: Biological Sciences **272**(1572): 1547-1555.

Jenkins, W. E., T. I. J. Smith, L. D. Heyward, and D. M. Knott. 1993. Tolerance of shortnose sturgeon, *Acipenser brevirostrum*, juveniles to different salinity and dissolved oxygen concentrations. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies **47**: 476-484.

Jensen, A. and G. K. Silber. 2003. Large whale ship strike database. National Marine Fisheries Service, Office Protected Resources, Silver Spring, Maryland. Dated January. NOAA Technical Memorandum NMFS-OPR-25.

Kahn, J., C. Hager, J. C. Watterson, J. Russo, K. Moore, and K. Hartman. 2014. Atlantic sturgeon annual spawning run estimate in the Pamunkey River, Virginia. Transactions of the American Fisheries Society **143**(6): 1508-1514.

Kahnle, A. W., K. A. Hattala, and K. A. McKown. 2007. Status of Atlantic sturgeon of the Hudson River Estuary, New York, USA. In Munro, J., Hatin, D., Hightower, J.E., McKown, K.A., Sulak, K.J., Kahnle, A.W. and Caron, F. (Eds.), *Anadromous Sturgeons: Habitats, Threats, and Management*. American Fisheries Society Symposium 56: 347-363. American Fisheries Society, Bethesda, Maryland.

Kahnle, A. W., K. A. Hattala, K. A. McKown, C. A. Shirey, M. R. Collins, T. S. Squiers, T. Savoy, D. H. Secor, and J. A. Musick. 1998. Stock Status of Atlantic Sturgeon of Atlantic Coast Estuaries. Report for the Atlantic States Marine Fisheries Commission.

Keinath, J., J. Musick, and R. Byles. 1987. Aspects of the biology of Virginia's sea turtles: 1979-1986. Virginia Journal of Science **38**(4): 331.

Kocik, J., C. Lipsky, T. Miller, P. Rago, and G. Shepherd. 2013. An Atlantic Sturgeon Population Index for ESA Management Analysis [online]. Northeast Fisheries Science Center Reference Document **13-06**: 36.

Kynard, B. and M. Horgan. 2002. Ontogenetic behavior and migration of Atlantic Sturgeon, *Acipenser oxyrinchus oxyrinchus*, and Shortnose Sturgeon, *A. brevirostrum*, with notes on social behavior. Environmental Biology of Fishes **63**(2): 137-150.

Kynard, B., M. Horgan, M. Kieffer, and D. Seibel. 2000. Habitats used by Shortnose Sturgeon in two Massachusetts Rivers, with notes on estuarine Atlantic Sturgeon: A hierarchical approach. Transactions of the American Fisheries Society **129**(2): 487-503.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science **17**(1): 35-75.

Laney, R. W., J. E. Hightower, B. R. Versak, M. F. Mangold, W. W. Cole, Jr., and S. E. Winslow. 2007. Distribution, habitat use, and size of Atlantic Sturgeon captured during cooperative winter tagging cruises, 1988–2006. In Munro, J., Hatin, D., Hightower, J.E., McKown, K.A., Sulak, K.J., Kahnle, A.W. and Caron, F. (Eds.), *Anadromous sturgeons:*

Habitats, threats, and management. American Fisheries Society, Symposium 56: 167-182. American Fisheries Society, Bethesda, Maryland.

LaSalle, M. W. 1990. Physical and chemical alterations associated with dredging. In Simenstad, C.A. (Ed.), *Proceedings of the workshop on the effects of dredging on Anadromous Pacific coast fishes* (pp. 1-12), Washington Sea Grant Program, Seattle.

Leland, J. G. 1968. A survey of the sturgeon fishery of South Carolina. Bears Bluff Laboratories.

Lichter, J., H. Caron, T. S. Pasakarnis, S. L. Rodgers, T. S. Squiers, Jr., and C. S. Todd. 2006. The ecological collapse and partial recovery of a freshwater tidal ecosystem. Northeatern Naturalist **13**(2): 153-178.

Logan-Chesney, L. M., M. J. Dadswell, R. H. Karsten, I. Wirgin, and M. J. W. Stokesbury. 2018. Atlantic sturgeon *Acipenser oxyrinchus* surfacing behaviour. Journal of Fish Biology **92**(4): 929-943.

Lutcavage, M. E. and P. L. Lutz. 1997. Diving Physiology. In Lutz, P.L. and Musick, J.A. (Eds.), *The biology of sea turtles*. CRC Marine Science Series I: 277-296. CRC Press, Boca Raton, Florida.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. 1997. Human impacts on sea turtle survival. In Lutz, P.L. and Musick, J.A. (Eds.), *The biology of sea turtles* (Volume I, pp. 387-409). CRC Press, Boca Raton, Florida.

Magnuson, J. J., K. Bjorndal, W. DuPaul, G. Graham, D. Owens, C. Peterson, P. Pritchard, J. Richardson, G. Saul, and C. West. 1990. Decline of the sea turtles: causes and prevention. Natl. Research Council, Natl. Acad. Sci. Press, Washington DC.

Masuda, A. 2010. Natal origin of juvenile loggerhead turtles from foraging ground in Nicaragua and Panama estimated using mitochondria DNA. Unpublished Masters of Science, California State University, Chico.

McCauley, R., J. Fewtrell, A. Duncan, C. Jenner, M. Jenner, J. Penrose, R. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys—a study of environmental implications. The APPEA Journal **40**(1): 692-708.

McCord, J. W., M. R. Collins, W. C. Post, and T. I. J. Smith. 2007. Attempts to develop an index of abundance for age-1 Atlantic sturgeon in South Carolina, USA. In Munro, J., Hatin, D., Hightower, J.E., McKown, K.A., Sulak, K.J., Kahnle, A.W. and Caron, F. (Eds.), *Anadromous Sturgeons: Habitats, Threats, and Management*. American Fisheries Society, Symposium 56: 397-404. American Fisheries Society, Bethesda, Maryland.

Meylan, A. 1982. Estimation of population size in sea turtles. In Bjorndal, K.A. (Ed.), *Biology and conservation of sea turtles* (1 ed., pp. 1385-1138). Smithsonian Institution Press, Washington, D.C.

Miller, T. and G. Shepard. 2011. Summary of discard estimates for Atlantic sturgeon. Dated August 19, 2011. Northeast Fisheries Science Center, Population Dynamics Branch.

Miranda, L. E. and K. J. Killgore. 2013. Entrainment of shovelnose sturgeon by towboat navigation in the Upper Mississippi River. Journal of Applied Ichthyology **29**(2): 316-322.

Mitchell, G. H., R. D. Kenney, A. M. Farak, and R. J. Campbell. 2002. Evaluation of occurrence of endangered and threatened marine species in naval ship trial areas and transit lanes in the Gulf of Maine and offshore of Georges Bank. Naval Undersea Warfare Center Division, Newport, Rhode Island. Dated September 30. NUWC-NPT Technical Memo 02-121.

Mohler, J. W. 2003. Culture manual for the Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*. U.S. Fish and Wildlife Service, Region 5, 300 Westgate Center Drive, Hadley, Massachusetts.

Morreale, S. J. and E. Standora. 2005. Western North Atlantic waters: crucial developmental habitat for Kemp's ridley and loggerhead sea turtles. Chelonian Conservation and Biology **4**(4): 872-882.

Morreale, S. J. and E. A. Standora. 1994. Occurence, movement and behavior of the Kemp's ridley and other sea turtles in New York waters. April 1988 - March 1993. Okeanos Ocean Research Foundation, Hampton Bays, New York. New York Department of Environmental Conservation/Return a Gift to Wildlife Program Contract No. C001984.

Morreale, S. J. and E. A. Standora. 1998. Early life stage ecology of sea turtles in northeastern U.S. waters. NOAA Technical Memorandum NMFS-SEFSC-413: 49. National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida.

Murawski, S. A. and A. L. Pacheco. 1977. Biological and fisheries data on Atlantic Sturgeon, *Acipenser oxyrhynchus* (Mitchill). National Marine Fisheries Service, Northeast Fisheries Science Center, Sandy Hook Laboratory, Highlands, New Jersey. Dated August 1977. Technical Series Report 10 No. 10.

Murdoch, P. S., J. S. Baron, and T. L. Miller. 2000. Potential effects of climate change on surface-water quality in North America. JAWRA Journal of the American Water Resources Association **36**(2): 347-366.

Murray, K. T. 2015a. Estimated loggerhead (*Caretta caretta*) interactions in the Mid-Atlantic scallop dredge fishery, 2009-2014. National Marine Fisheries Service, Woods Hole, Massachusetts. Dated September.

Murray, K. T. 2015b. The importance of location and operational fishing factors in estimating and reducing loggerhead turtle (*Caretta caretta*) interactions in U.S. bottom trawl gear. Fisheries Research **172**: 440-451.

Murray, K. T. 2018. Estimated bycatch of sea turtles in sink gillnet gear. National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts. Dated April. NOAA Technical Memorandum NMFS-NE-242.

Murray, K. T. 2020. Estimated magnitude of sea turtle interactions and mortality in U.S. bottom trawl gear, 2014-2018. National Marine Fisheries Service, Woods Hole, Massachusetts. Dated 2020. Northeast Fisheries Science Center Technical Memorandum No. NMFS-NE-260.

Musick, J., R. Jenkins, and N. Burkhead. 1994. Sturgeons, family Acipenseridae. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, MD: 183-190.

Musick, J. A. and C. J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. In Lutz, P.L. and Musick, J.A. (Eds.), *The biology of sea turtles* (Volume I, pp. 137-164). CRC Press, Boca Raton, Florida.

NAST (National Assessment Synthesis Team). 2000. Climate change impacts on the United States: The potential consequences of climate variability and change. Overview. U.S. Global Change Research Program, Washington D.C.

National Marine Fisheries Service (NMFS). 1995. Endangered Species Act - section 7 consultation biological opinion on the United States Coast Guard vessel and aircraft activities along the Atlantic coast. National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts.

National Marine Fisheries Service (NMFS). 1996. National Marine Fisheries Service Endangered Species Act - section 7 consultation biological opinion on the reinitiation of consultation on the United States Coast Guard and aircraft activities along the Atlantic coast. National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts. Dated July 22, 1996.

National Marine Fisheries Service (NMFS). 1998. National Marine Fisheries Service Endangered Species Act - section 7 consultation biological opinion on the section reinitiation of consultation on United States Coast Guard vessel and aircraft activities along the Atlantic coast. National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts. Dated June 8, 1998.

National Marine Fisheries Service (NMFS). 2000. National Marine Fisheries Service Endangered Species Act section 7 consultation biological opinion on the New York and New Jersey Harbor Navigation Project (F/NER/2000/00596). National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts No. NER-2000-00596.

Nelson, D. A. and D. J. Shafer. 1996. Effectiveness of a sea turtle-deflecting hopper dredge draghead in Port Canaveral entrance channel, Florida. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi. Dated August. Miscellaneous Paper No. D-96-3.

Nightingale, B. and C. A. Simenstad. 2001. Dredging activities: Marine issues. University of Washington, Seattle, Washington. Dated July 13, 2001. Report No. WA-RD 507.1.

Niklitschek, E. J. 2001. Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (*Acipenser oxyrinchus and A. brevirostrum*) in the Chesapeake Bay. Unpublished Doctor of Philosophy, Faculty of the Graduate School, University of Maryland: College Park, Maryland.

Niklitschek, E. J. and D. H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science **64**(1): 135-148.

Niklitschek, E. J. and D. H. Secor. 2010. Experimental and field evidence of behavioural habitat selection by juvenile Atlantic Acipenser oxyrinchus oxyrinchus and shortnose Acipenser brevirostrum sturgeons. Journal of Fish Biology **77**(6): 1293-1308.

NMFS. 2002. Endangered Species Act section 7 consultation on shrimp trawling in the Southeastern United States, under the Sea Turtle Conservation Regulations and as managed by the Fishery Management Plans for Shrimp in the South Atlantic and Gulf of Mexico. National Marine Fisheries Service, Southeast Regioinal Office. Dated December 2. Biological Opinion.

NMFS. 2005. Recovery plan for the North Atlantic right whale (*Eubalaena glacialis*). Revison. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland. Dated May 26.

NMFS. 2010. Final recovery plan for the fin whale. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland. Dated July 30, 2010.

NMFS. 2013. Endangered Species Act section 7 consultation on the continued implementation of management measures for the northeast multispecies, monkfish, spiny dogfish, Atlantic bluefish, northeast skate complex, mackerel/squid/butterfish, and summer flounder/scup/black sea bass fisheries. National Marine Fisheries Service, Northeast Regional Office. Dated December 16. Biological Opinion NER-2012-01956.

NMFS. 2014. Endangered Species Act Section 7(a)(2) Biological Opinion - Beach nourishment projects utilizing the Sea Bright offshore borrow area: Union Beach, Port Monmouth, and Elberon to Loch Arbour, New Jersey (NER-2014-10606). National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts.

NMFS. 2017a. Designation of critical habitat for the Gulf of Maine, New York Bight, and Chesapeake Bay Distinct Population Segments of Atlantic sturgeon. ESA Section 4(b)(2) impact analysis and biological source document with the economic analysis and final regulatory flexibility analysis. National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts. Dated June 3.

NMFS. 2017b. Endangered and Threatened Species; designation of critical habitat for the endangered New York Bight, Chesapeake Bay, Carolina and South Atlantic Distinct Population Segments of Atlantic sturgeon and the threatened Gulf of Maine Distinct Population Segment of Atlantic sturgeon. Federal Register **82**(158): 39160-39274.

NMFS and USFWS. 1991. Recovery plan for U.S. population of Atlantic green turtle (*Chelonia mydas*). National Marine Fisheries Service and U.S. Fish and Wildlife Service, Washington, D.C.

NMFS and USFWS. 1992. Recovery plan for leatherback turtles (*Dermochelys coriacea*) in the U.S. Caribbean, Atlantic and Gulf of Mexico. National Marine Fisheris Service and U.S. Fish and Wildlife Service, Washington, D.C.

NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 1998a. Recovery plan for U.S. Pacific populations of the leatherback sea turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 1998b. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service and U.S. Fish and Wildlife Service. Dated July 24, 1998.

NMFS and USFWS. 2007. Green sea turtle (*Chelonia mydas*) 5-year review: Summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Jacksonville, Florida. Dated August.

NMFS and USFWS. 2008. Recovery plan for the Northwest Atlantic population of the loggerhead sea turtle, Second revision. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.

NMFS and USFWS. 2013. Leatherback sea turtle (*Dermochelys coriacea*) 5-year review: Summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland, and U.S. Fish and Wildlife Service, Jacksonville, Florida. Dated November.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 2007. Loggerhead sea turtle (*Caretta caretta*) 5-Year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Jacksonville, Florida. Dated August.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 2008. Recovery plan for the Northwest Atlantic population of the Loggerhead sea turtle (*Caretta caretta*), second revision. National Marine Fisheries Service and United States Fish and Wildlife Service, Silver Spring, Maryland.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 2015. Kemp's ridley sea turtle (*Lepidochelys kempii*). 5-year review: Summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. Dated July.

NMFS (National Marine Fisheries Service), USFWS (U.S. Fish and Wildlife Service), and SEMARNAT (Secretariat of Environment & Natural Resources). 2011. Bi-National recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, Silver Spring, Maryland. Dated September 22, 2011.

NMFS SEFSC. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the western North Atlantic. National Marine Fishery Service, Southeast Fisheries Science Center, Miami, Florida. Dated March. NOAA Technical Memorandum No. NMFS-SEFSC-455.

NMFS SEFSC (National Marine Fisheries Service Southeast Fisheries Science Center). 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS, Southeast Fisheries Science Center, Miami, Florida. Dated July. NMFS-SEFSC Contribution PRD-08/09-14.

NRC, (National Research Council). 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington D.C. 280 pp.

O'Leary, S. J., K. J. Dunton, T. L. King, M. G. Frisk, and D. D. Chapman. 2014. Genetic diversity and effective size of Atlantic sturgeon, *Acipenser oxyrhinchus oxyrhinchus* river spawning populations estimated from the microsatellite genotypes of marine-captured juveniles. Conservation Genetics **15**(5): 1173-1181.

Oakley, N. C. 2003. Status of shortnose sturgeon, *Acipenser brevirostrum*, in the Neuse River, North Carolina. Unpublished Master of Science, North Carolina State University: Raleigh, N.C.

Oliver, M. J., M. W. Breece, D. A. Fox, D. E. Haulsee, J. T. Kohut, J. Manderson, and T. Savoy. 2013. Shrinking the haystack: using an AUV in an integrated ocean observatory to map Atlantic Sturgeon in the coastal ocean. Fisheries **38**(5): 210-216.

Ong, T.-L., J. Stabile, I. Wirgin, and J. R. Waldman. 1996. Genetic divergence between Acipenser oxyrinchus oxyrinchus and A. o. desotoi as assessed by mitochondrial DNA sequencing analysis. Copeia **1996**(2): 464-469.

Palmer, M. A., C. A. Reidy Liermann, C. Nilsson, M. Flörke, J. Alcamo, P. S. Lake, and N. Bond. 2008. Climate change and the world's river basins: anticipating management options. Frontiers in Ecology and the Environment **6**(2): 81-89.

Parga, M., J. Crespo-Picazo, D. Monteiro, D. García-Párraga, J. Hernandez, Y. Swimmer, S. Paz, and N. Stacy. 2020. On-board study of gas embolism in marine turtles caught in bottom trawl fisheries in the Atlantic Ocean. Scientific reports **10**(1): 1-9.

Pershing, A. J., M. A. Alexander, C. M. Hernandez, L. A. Kerr, A. Le Bris, K. E. Mills, J. A. Nye, N. R. Record, H. A. Scannell, J. D. Scott, G. D. Sherwood, and A. C. Thomas. 2015. Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. Science **350**: 809-812.

Plachta, D. T. T. and A. N. Popper. 2003. Evasive responses of American shad (*Alosa sapidissima*) to ultrasonic stimuli. Acoustics Research Letters Online **4**(2): 25-30.

Post, W. C., T. Darden, D. L. Peterson, M. Loeffler, and C. Collier. 2014. Research and management of endangered and threatened species in the southeast: riverine movements of Shortnose and Atlantic sturgeon. South Carolina Department of Natural Resources, Project NA10NMF4720036, Final Report, Charleston.

Price, E. R., B. P. Wallace, R. D. Reina, J. R. Spotila, F. V. Paladino, R. Piedra, and E. Vélez. 2004. Size, growth, and reproductive output of adult female leatherback turtles *Dermochelys coriacea*. Endangered Species Research **1**: 41-48.

Purser, J. and A. N. Radford. 2011. Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (*Gasterosteus aculeatus*). PLoS ONE **6**(2): e17478.

Pyzik, L., J. Caddick, and P. Marx. 2004. Chesapeake Bay: Introduction to an ecosystem (Update). Chesapeake Bay Program, Annapolis, Maryland. Dated July 2004. Report No. CBP/TRS 232/00.

Reina, R. D., P. A. Mayor, J. R. Spotila, R. Piedra, and F. V. Paladino. 2002. Nesting ecology of the leatherback turtle, *Dermochelys coriacea*, at Parque Nacional Marino las Baulas, Costa Rica: 1988–1989 to 1999–2000. Copeia **2002**(3): 653-664.

Reine, K. J., D. Clarke, M. Balzaik, S. O'Haire, C. Dickerson, C. Fredrickson, G. Garman, C. Hager, A. J. Spells, and C. Turner. 2014. Assessing impacts of navigation dredging on Atlatntic sturgeon (*Acipenser oxyrinchus*). U.S. Army Corps of Eningeers, Engineer Research and Development Center, 3909 Halls Ferry Rd, Vicksburg, MS 39180. Dated November 2014. Dredging Operations Technical Support Program No. ERDC/EL TR-14-12.

Revkin, A. 2019. 14-foot fish spotted in river, giving hope to vanished giant’s return. *In* National Geographic.

Ross, J. P. 1996. Caution urged in the interpretation of trends at nesting beaches. Marine Turtle Newsletter **74**: 9-10.

Ruben, H. J. and S. J. Morreale. 1999. Draft biological assessment for sea turtles New York and New Jersey harbor complex. U.S. Army Corps of Engineers, North Atlantic Division, New York District, 26 Federal Plaza, New York, NY 10278-0090. Dated September 1999.

Saba, V. S., S. M. Griffies, W. G. Anderson, M. Winton, M. A. Alexander, T. L. Delworth, J. A. Hare, M. J. Harrison, A. Rosati, G. A. Vecchi, and R. Zhang. 2015. Enhanced warming of the Northwest Atlantic Ocean under climate change. Journal of Geophysical Research: Oceans **121**(1): 118-132.

Sasso, C. R. and S. P. Epperly. 2006. Seasonal sea turtle mortality risk from forced submergence in bottom trawls. Fisheries Research **81**(1): 86-88.

Savoy, T. 2007. Prey eaten by Atlantic sturgeon in Connecticut waters. In Munro, J., Hatin, D., Hightower, J.E., McKown, K.A., Sulak, K.J., Kahnle, A.W. and Caron, F. (Eds.), *Anadromous Sturgeons: Habitats, Threats, and Management*. American Fisheries Society Symposium 56: 157-165. American Fisheries Society, Bethesda, Maryland.

Savoy, T., L. Maceda, N. K. Roy, D. Peterson, and I. Wirgin. 2017. Evidence of natural reproduction of Atlantic sturgeon in the Connecticut River from unlikely sources. PLoS ONE **12**(4): e0175085.

Savoy, T. and D. Pacileo. 2003. Movements and important habitats of subadult Atlantic sturgeon in Connecticut waters. Transactions of the American Fisheries Society **132**: 1-8.

Schmid, J. R. 1998. Marine turtle populations on the west-central coast of Florida: results of tagging studies at the Cedar Keys, Florida, 1986-1995. Fishery Bulletin **96**(3): 589-602.

Schueller, P. and D. L. Peterson. 2010. Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia. Transactions of the American Fisheries Society **139**(5): 1526-1535.

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin **184**.

Secor, D. H. 2002. Atlantic sturgeon fisheries and stock abundances during the late nineteenth century. In Van Winkle, W., PhD, Anders, P., Secor, D.H., PhD and Dixon, D., PhD (Eds.), *Biology, Management, and Protection of North American Sturgeon*. American Fisheries Society Symposium 28: 89-98. American Fisheries Society, Bethesda, Maryland.

Secor, D. H., E. J. Niklitschek, J. T. Stevenson, T. E. Gunderson, S. P. Minkkinen, B. Richardson, B. Florence, M. Mangold, J. Skjeveland, and A. Henderson-Arzapalo. 2000. Dispersal and growth of yearling Atlantic sturgeon, *Acipenser oxyrinchus*, released into Chesapeake Bay. Fishery Bulletin **98**(4): 800-800.

Secor, D. H. and J. R. Waldman. 1999. Historical abundance of Delaware Bay Atlantic sturgeon and potential rate of recovery. In Musick, J.A. (Ed.), *Life in the Slow Lane: Ecology and*

Conservation of Long-Lived Marine Animals. American Fisheries Society Symposium 23: 203-216. American Fisheries Society, Bethesda, Maryland.

Seminoff, J. A., C. D. Allen, G. H. Balazs, P. H. Dutton, T. Eguchi, H. L. Haas, S. A. Hargrove, M. Jensen, D. L. Klemm, A. M. Lauritsen, S. L. MacPherson, P. Opay, E. E. Possardt, S. P. Pultz, E. Seney, K. S. Van Houtan, and R. S. Waples. 2015. Status review of the green turtle (*Chelonia mydas*) under the Endangered Species Act. NMFS, Southwest Fisheries Science Center, Maiami, Florida. NOAA Technical Memorandum NMFS-SWFCS-539.

Shamblin, B. M., A. B. Bolten, F. A. Abreu-Grobois, K. A. Bjorndal, L. Cardona, C. Carreras, M. Clusa, C. Monzón-Argüello, C. J. Nairn, J. T. Nielsen, R. Nel, L. S. Soares, K. R. Stewart, S. T. Vilaça, O. Türkozan, C. Yilmaz, and P. H. Dutton. 2014. Geographic patterns of genetic variation in a broadly distributed marine vertebrate: New insights into loggerhead turtle stock structure from expanded mitochondrial DNA Sequences. PLoS ONE **9**(1): e85956.

Shamblin, B. M., A. B. Bolten, K. A. Bjorndal, P. H. Dutton, J. T. Nielsen, F. A. Abreu-Grobois, K. J. Reich, B. E. Witherington, D. A. Bagley, and L. M. Ehrhart. 2012. Expanded mitochondrial control region sequences increase resolution of stock structure among North Atlantic loggerhead turtle rookeries. Marine Ecology Progress Series **469**: 145-160.

Shamblin, B. M., P. H. Dutton, D. J. Shaver, D. A. Bagley, N. F. Putman, K. L. Mansfield, L. M. Ehrhart, L. J. Peña, and C. J. Nairn. 2016. Mexican origins for the Texas green turtle foraging aggregation: A cautionary tale of incomplete baselines and poor marker resolution. Journal of Experimental Marine Biology and Ecology **488**: 111-120.

Shirey, C. A., C. C. Martin, and E. J. Stetzar. 1997. Abundance of sub-adult Atlantic sturgeon and areas of concentration within the lower Delaware River. Time period covered August 1, 1996–September 30, 1997. Final report. Delaware Division of Fish and Wildlife, Dover, Delaware.

Shoop, C. R. and R. D. Kenney. 1992. Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the Northeastern United States. Herpetological Monographs **6**: 43-67.

Slay, C. K. and J. I. Richardson. 1988. Kings Bay, Georgia: Dredging and Turtles. In Schroeder, B.A. (Ed.), *Proceedings of the Eight Annual Workshop on Sea Turtle Conservation and Biology. Forth Fisher, North Carolina, 24-26 February 1988*. NOAA Technical Memorandum 109-111. National Marine Fisheries Service, Miami, Florida.

Smith, T. I. J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrhynchus*, in North America. Environmental Biology of Fishes **14**(1): 61-72.

Smith, T. I. J. and J. P. Clugston. 1997. Status and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in North America. Environmental Biology of Fishes **48**(1): 335-346.

Smith, T. I. J., E. K. Dingley, and D. E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon. The Progressive Fish-Culturist **42**(3): 147-151.

Smith, T. I. J., D. E. Marchette, and R. A. Smiley. 1982. Life history, ecology, culture and management of Atlantic sturgeon, A*cipenser oxyrhynchus oxyrhynchus*, Mitchill, in South Carolina. South Carolina Wildlife Marine Resources. Resources Department, Final Report to U.S. Fish and Wildlife Service. Report No. AFS-9.

Smith, T. I. J., D. E. Marchette, and G. F. Ulrich. 1984. The Atlantic sturgeon fishery in South Carolina. North American Journal of Fisheries Management **4**(2): 164-176.

Southall, B. L. and A. Scholik-Schlomer. 2008. Final Report of the National Oceanic and Atmospheric Administration (NOAA) International Symposium: Potential application of vessel-quieting technology on large commercial vessels. Silver Spring, Maryland, 1-2 May, 2007.
Spotila, J. R., A. E. Dunham, A. J. Leslie, A. C. Steyermark, P. T. Plotkin, and F. V. Paladino. 1996. Worldwide population decline of *Dermochelys coriacea*: Are leatherback turtles going extinct? Chelonian Conservation and Biology **2**(2): 209-222.

Spotila, J. R., R. D. Reina, A. C. Steyermark, P. T. Plotkin, and F. V. Paladino. 2000. Pacific leatherback turtles face extinction. Nature **405**(6786): 529-530.

Squiers, T., M. Smith, and L. Flagg. 1979. Distribution and abundance of shortnose and Atlantic sturgeon in the Kennebec River estuary. Department of Marine Resources, Augusta, Maine. Research Reference Document No. 79/13.

Squiers, T. S., Jr. 2004. Atlantic sturgeon compliance report to the Atlantic Sates Marine Fisheries Commission. Dated December 22, 2004.

Stacy, B. A. 2012. Summary of findings for sea turtles documented by directed captures, stranding response, and incidental captures under response operations during the BP Deepwater Horizon (Mississippi Canyon 252) oil spill. NMFS. Report No. DWH-ARO149670.

Stacy, N. I. and C. J. Innis. 2012. Analysis and interpretation of hematology and blood chemistry values in live sea turtles documented by response operations during the 2010 BP Deepwater Horizon oil spill response. ST_TR. 14. DWH Sea Turtles NRDA Technical Working Group Report.

Stadler, J. H. and D. P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. (Report). Presented at the Inter Noise, Ottawa, Canada, August 23-26, 2009. 8 pp.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004a. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the Northeast United States. North American Journal of Fisheries Management **24**(1): 171-183.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004b. Atlantic Sturgeon marine distribution and habitat use along the northeastern coast of the United States. Transactions of the American Fisheries Society **133**(3): 527-537.

Stevenson, J. T. and D. H. Secor. 1999. Age determination and growth of Hudson River Atlantic sturgeon, Acipenser oxyrinchus. Fishery Bulletin **98**(1): 153-166.

Sulak, K. and M. Randall. 2002. Understanding sturgeon life history: enigmas, myths, and insights from scientific studies. Journal of Applied Ichthyology **18**(4-6): 519-528.

Sweka, J. A., J. Mohler, M. J. Millard, T. Kehler, A. Kahnle, K. Hattala, G. Kenney, and A. Higgs. 2007. Juvenile Atlantic sturgeon habitat use in Newburgh and Haverstraw Bays of the Hudson River: Implications for population monitoring. North American Journal of Fisheries Management **27**(4): 1058-1067.

Swimmer, Y., C. Empey Campora, L. McNaughton, M. Musyl, and M. Parga. 2014. Post-release mortality estimates of loggerhead sea turtles (*Caretta caretta*) caught in pelagic longline fisheries based on satellite data and hooking location. Aquatic Conservation: Marine and Freshwater Ecosystems **24**(4): 498-510.

Tapilatu, R. F., P. H. Dutton, M. Tiwari, T. Wibbels, H. V. Ferdinandus, W. G. Iwanggin, and B. H. Nugroho. 2013. Long-term decline of the western Pacific leatherback, *Dermochelys coriacea*: a globally important sea turtle population. Ecosphere **4**(2): 1-15.

Taylor, A. D., K. Ohashi, J. Sheng, and M. K. Litvak. 2016. Oceanic distribution, behaviour, and a winter aggregation area of adult Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus,* in the Bay of Fundy, Canada. PLoS ONE **11**(4).

Tetra Tech. 2019. Borrow area study for the Atlantic coast of Long Island, FIMI, New York, storm damage reduction project. Prepared for U.S. Army Corps of Engineers. Dated May 2019. Biological and environmental services related to marine and navigable waterways civil works activities in the New York District.

TEWG, (Turtle Expert Working Group). 1998. An assessment of the Kemp's Ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the western north Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409: 96. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.

TEWG, (Turtle Expert Working Group). 2000. Assessment update for the Kemp's Ridley and loggerhead sea turtle populations in the western north Atlantic. NOAA Technical Memorandum NMFS-SEFSC-444: 1-115. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.

TEWG, (Turtle Expert Working Group). 2007. An assessment of the leatherback turtles population in the Atlantic ocean. NOAA Technical Memorandum NMFS-SEFSC-555: 116. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.

TEWG, (Turtle Expert Working Group). 2009. An assessment of the loggerhead turtle population in the Western Northern Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575: 131. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.

Theodore, I., J. Smith, E. K. Dingley, and D. E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon. The Progressive Fish-Culturist **42**(3): 147-151.

Timoshkin, V. 1968. Atlantic sturgeon (*Acipenser sturio L.*) caught at sea. Journal of Ichthyology **8**(4): 598.

Tomás, J. and J. A. Raga. 2008. Occurrence of Kemp's ridley sea turtle (*Lepidochelys kempii*) in the Mediterranean. Marine Biodiversity Records **1**: 2.

Upite, C., K. T. Murray, B. Stacy, L. Stokes, and S. Weeks. 2019. Mortality Rate Estimates for Sea Turtles in Mid-Atlantic and Northeast Fishing Gear, 2012-2017. National Marine Fisheries Service, Gloucester, Massachusetts. Greater Atlantic Region Policy Series 19-03.

USACE, (U.S. Army Corps of Engineers). 2013. Final environmental assessment Delaware River main channel deepening project Delaware Bay economic loading, mechanical dredging and placement of dredged material at the Fort Mifflin confined disposal facility. USACE, Philadelpha District, Philadelphia, Pennsylvania. Dated November 2013. Environmental Assessment.

USACE (U.S. Army Corps of Engineers). ODESS - Operations and Dredging Endangered Species System - Management Tool [Online Database]. United States Army Corps of Engineers. Retrived, from https://dqm.usace.army.mil/odess/#/home.

USACE (U.S. Army Corps of Engineers). 1983. Dredging and dredged material disposal. U.S. Army Corps of Engineers, Office of the Chief of Engineers, Washington D.C. Dated March 25, 1983. Eningeer Manual No. 1110-2-5025.

USACE (U.S. Army Corps of Engineers). 2015. New York and New Jersey Harbor deepening project - Dredge plume dynamics in New York/New Jersey Harbor: Summary of suspended plume surveys performed during harbor deepening. 133.

USFWS and NMFS (U.S. Fish and Wildlife Service and National Marine Fisheries Service). 1992. Recovery Plan for the Kemp's Ridley Sea Turtle *Lepidochelys kempii*. The U.S. Fish and Wildlife Service and National Marine Fisheries Service, St. Petersburg, Forida.

Van Den Avyle, M. J. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic): Atlantic sturgeon. Volume 82. The Service.

Van Eenennaam, J. P., S. I. Doroshov, G. P. Moberg, J. G. Watson, D. S. Moore, and J. Linares. 1996. Reproductive conditions of the Atlantic sturgeon (*Acipenser oxyrinchus*) in the Hudson River. Estuaries **19**(4): 769-777.

Vanderlaan, A. S. M. and C. T. Taggart. 2006. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Marine Mammal Science **23**(1): 144-156.

Vladykov, V. D. and J. R. Greeley. 1963. Order *Acipenseroidei*. In Bigelow, H.B. (Ed.), *Fishes of the Western North Atlantic, Part 3*. Memoir (Sears Foundation for Marine Research) I: 630. Yale University, New Haven, Connecticut. DOI: 10.5962/bhl.title.7464.

Waldman, J. R., J. T. Hart, and I. I. Wirgin. 1996a. Stock composition of the New York Bight Atlantic sturgeon fishery based on analysis of mitochondrial DNA. Transactions of the American Fisheries Society **125**(3): 364-371.

Waldman, J. R., T. King, T. Savoy, L. Maceda, C. Grunwald, and I. Wirgin. 2013. Stock origins of subadult and adult Atlantic sturgeon, *Acipenser oxyrinchus*, in a non-natal estuary, Long Island Sound. Estuaries and Coasts **36**(2): 257-267.

Waldman, J. R., K. Nolan, and J. Hart. 1996b. Genetic differentiation of three key anadromous fish populations of the Hudson River. Estuaries **19**(4): 759-768.

Waldman, J. R. and I. I. Wirgin. 1998. Status and restoration options for Atlantic sturgeon in North America. Conservation Biology **12**(3): 631-638.

Wallace, B. and K. Eckert. 2018. Northwest atlantic leatherback turtle *(Dermochelys coriacea*) status assessment. Prepared by the Northwest Atlantic Leatherback Working Group. Conservation Science Partners and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), Godfrey, Illinois. WIDECAST Technical Report No. 16. DOI: 1930-3025.

Wallace, B. P., A. D. DiMatteo, B. J. Hurley, E. M. Finkbeiner, A. B. Bolten, M. Y. Chaloupka, B. J. Hutchinson, F. A. Abreu-Grobois, D. Amorocho, and K. A. Bjorndal. 2010. Regional management units for marine turtles: a novel framework for prioritizing conservation and research across multiple scales. PLoS ONE **5**(12).

Wallace, B. P., S. S. Kilham, F. V. Paladino, and J. R. Spotila. 2006. Energy budget calculations indicate resource limitation in Eastern Pacific leatherback turtles. Marine Ecology Progress Series **318**: 263-270.

Wallace, B. P., P. R. Sotherland, P. S. Tomillo, R. D. Reina, J. R. Spotila, and F. V. Paladino. 2007. Maternal investment in reproduction and its consequences in leatherback turtles. Oecologia **152**(1): 37-47.

Watanabe, Y., Q. Wei, D. Yang, X. Chen, H. Du, J. Yang, K. Sato, Y. Naito, and N. Miyazaki. 2008. Swimming behavior in relation to buoyancy in an open swimbladder fish, the Chinese sturgeon. Journal of Zoology **275**(4): 381-390.

Welsh, S. A., S. M. Eyler, M. F. Mangold, and A. J. Spells. 2002. Capture locations and growth rates of Atlantic sturgeon in the Chesapeake Bay. In Van Winkle, W., PhD, Anders, P., Secor, D.H., PhD and Dixon, D., PhD (Eds.), *Biology, Management, and Protection of North American Sturgeon*. American Fisheries Society Symposium 28: 183-194. American Fisheries Society, Bethesda, Maryland.

Wilber, D. H. and D. G. Clarke. 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Management **21**(4): 855-875.

Wilber, D. H., D. G. Clarke, and M. H. Burlas. 2006. Suspended sediment concentrations associated with a beach nourishment project on the northern coast of New Jersey. Journal of Coastal Research **22**(5): 1035-1042.

Winn, H. E., R. K. Edel, and CeTAP. 1982. A characterization of marine mammals and turtles in the mid-and north Atlantic areas of the US outer continental shelf. Final report. Sponsored by the Bureau of Land Management under contract AA551-CT8-48. .

Wippelhauser, G. 2012. Summary of Maine Atlantic sturgeon data: Description of monitoring 1977-2001 and 2009-2011 in the Kennebec and Merrymeeting Bay Estuary System.

Wippelhauser, G. and T. S. Squiers. 2015. Shortnose Sturgeon and Atlantic Strurgeon in the Kennebec River System, Maine: a 1977-2001 Retrospective of Abundance and Important Habitat. Transactions of the American Fisheries Society **144**(3): 591-601.

Wirgin, I., M. W. Breece, D. A. Fox, L. Maceda, K. W. Wark, and T. King. 2015a. Origin of Atlantic Sturgeon collected off the Delaware coast during spring months. North American Journal of Fisheries Management **35**(1): 20-30.

Wirgin, I. and T. King. 2011. Mixed stock analysis of Atlantic sturgeon from costal locals and a non-spawning river. Presented at the Sturgeon Workshop, Alexandria, Virginia, February 8-10, 2011.

Wirgin, I., L. Maceda, C. Grunwald, and T. L. King. 2015b. Population origin of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus* by-catch in U.S. Atlantic coast fisheries. Journal of Fish Biology **86**(4): 1251-1270.

Wirgin, I., L. Maceda, J. R. Waldman, S. Wehrell, M. Dadswell, and T. King. 2012. Stock origin of migratory Atlantic Sturgeon in Minas Basin, Inner Bay of Fundy, Canada, determined by microsatellite and mitochondrial DNA analyses. Transactions of the American Fisheries Society **141**(5): 1389-1398.

Wirgin, I., N. K. Roy, L. Maceda, and M. T. Mattson. 2018. DPS and population origin of subadult Atlantic Sturgeon in the Hudson River [online]. Fisheries Research **In Press**: 1-6. DOI: https://doi.org/10.1016/j.fishres.2018.06.004.

Wirgin, I. I., J. R. Waldman, J. Rosko, R. Gross, M. R. Collins, S. G. Rogers, and J. Stabile. 2000. Genetic structure of Atlantic sturgeon populations based on mitochondrial DNA control region sequences. Transactions of the American Fisheries Society **129**(2): 476-486.

Wirgin, I. I., J. R. Waldman, J. Stabile, B. A. Lubinski, and T. L. King. 2002. Comparison of mitochondrial DNA control region sequence and microsatellite DNA analyses in estimating population structure and gene flow rates in Atlantic sturgeon Acipenser oxyrinchus. Journal of Applied Ichthyology **18**(4-6): 313-319.

Witherington, B., P. Kubilis, B. Brost, and A. Meylan. 2009. Decreasing annual nest counts in a globally important loggerhead sea turtle population. Ecological Applications **19**(1): 30-54.

Wysocki, L. E., S. Amoser, and F. Ladich. 2007. Diversity in ambient noise in European freshwater habitats: Noise levels, spectral profiles, and impact on fishes. The Journal of the Acoustical Society of America **121**(5): 2559-2566.

Young, J. R., T. B. Hoff, W. P. Dey, and J. G. Hoff. 1988. Management recommendations for a Hudson River Atlantic sturgeon fishery based on an age-structured population model. Fisheries Research in the Hudson River. State of University of New York Press, Albany, New York.

Ziegeweid, J. R., C. A. Jennings, and D. L. Peterson. 2008. Thermal maxima for juvenile shortnose sturgeon acclimated to different temperatures. Environmental Biology of Fishes **82**(3): 299-307.

Zurita, J. C., R. Herrera, A. Arenas, M. E. Torres, C. Calderón, L. Gomez, J. C. Alvarado, and R. Villavicencia. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Poster Presentations: Nesting Beaches and Threats: 125-127.

Zwinenberg, A. 1977. Kemp's ridley, *Lepidochelys kempii* (Garman 1880), undoubtedly the most endangered marine turtle today (with notes on the current status of *Lepidochelys olivacea*). Bulletin of the Maryland Herpetological Society **13**(3): 378-384.

15 Appendix A.

Historical Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Appendix A. Historical Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
1	30 Oct 90	SAC	Winyah Bay Georgetown	A	H *Ouchita*	Dead	~69cm, rear half	Overflow Screening	N	Chris Slay pers com Observer report DACW 60-90-C-0067
2	15 Jan 94	SAS	Savannah Harbor	A	H *RN Weeks*	NA	NA	Found by Turtle observer	No	Steve Calver pers com 14 Jun 05 Observer load sheet and final rpt #DACW21-93-C-0072
3	07 Dec 94	SAS	Savannah Harbor	A	H *Dodge Island*	Live released	71cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
4	07 Dec 94 Different Load	SAS	Savannah Harbor	A	H *Dodge Island*	Dead	77.5cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
5	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	83cm, female w/eggs	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
6	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	63cm, mature male	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
7	06 Jan 98	NAP	Delaware River Kinkora Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
8	12 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
9	13 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
10	7 Sep 98	SAW	Wilmington Har Cape Fear River	A	H *McFarland*	Dead	Head only (1 ft long)	In turtle Inflow screen		Observer incident report Pers com Bill Adams- SAW 26 Jul 04
11	01 Mar 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	Missing head and tail	Main Overflow Screening	No	Chris Slay pers com Observer reporting forms
12	12 Apr 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	71.6cm, whole fish	Starboard Overflow screening	No	Chris Slay pers com Observer reporting forms
13	03 Dec 00	SAW	Wilmington Har MOTSU	A	C *New York*	Dead	82.5cm, whole fish decomposing	In bucket	Y Not e-file Payonk? ?	Chris Slay pers com Phil Payonk pers com 30 Jul 04 Bill Adams pers com 28 Jul 04 #DACW54-00-C-0013

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
14	24 Feb 01	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Head only	Just mentions take on all forms, no other info.	No	Daily and Weekly Reports, Load sheet.
15	19 Jun 01	NAE	Kennebec River Bath Iron Works	A	C *??*	Live released		Put in scow, released unharmed		Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
16	30 Apr 03	NAE	Kennebec River Bath Iron Works	S	C Reed and Reed dredge company	Dead	Fish nearly cut in half		Y We have e-file	Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
17	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	38.1inches	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
18	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	37.0 inches	In hopper Did not dive Probably died	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
19	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Swam away	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
20	06 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	Found alive	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
21	08 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Good condition	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
22	07 Jan 04	SAC	Charleston Harbor	A	H *Manhattan Island*	Live	Whole fish 49 inches total length May have died later when released	Found by Coastwise turtle observers	Yes (We Have e-file)	Robert Chappell pers com 28 Jun 04 Observer daily report 7 Jan 04
23	13 Dec 04	SAM	Gulfport Harbor Channel	G	H *Bayport*	Dead	Trunk of fish 59.5cm	Found by turtle observers		Observer incident report Susan Rees pers com 7 Jan 05
24a	28 Dec 04	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Trunk of fish 2 ft, 1inch	Found by Turtle observers	Yes (We Have e-file)	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
24b	01 Jan 05	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Head only of fish 22.5cm	2nd part of take on 28 Dec 04	Yes taken But we Have not received	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
25	2 Mar 05	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Posterior section only 60 cm section w/tail	Found by turtle observer	Yes (We Have e-file)	Chris Slay pers com 7 Jun 05 Steve Calver pers com 14 Jun 05
26	26 Dec 06	SAS	Brunswick	A	H *Newport*	Dead	Head only	Caught in port screen and	Black and	Incident and load report

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
								turtle part caught in starboard screen	White	
27	17 Jan 07	SAS	Savannah Entrance Channel	A	H *Glenn Edwards*	Dead	Whole fish, FL 104 cm	Fresh Dead, 60 Horseshoe crab in with load	Coastwise took photo	Incident and Load report
28	2 Mar 09	SAS	Savannah Entrance Channel	A	H *Dodge Island*	Dead	Total Length 111 cm	Fresh Dead, found in starboard aft inflow box, load #42		Incident, Load and Daily report
29	6 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #19 with 12 Horseshoe crab		No incident report, just listed on load sheet and daily summary
30	7 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #25 with 20 Horseshoe crab		No incident report, just listed on load sheet and daily summary
31	2 Feb 10	SAS	Brunswick Entrance Channel	A	H *Bayport*	Dead	No measurements, head to mid body in load #193 and mid body to tail recovered in load #194.	Stbd screen contents, load #193 and overflow screen in #194,		No incident report, just listed on load sheet and daily summary
32	7 Dec 10	SAW	Wilmington Harbor	A	H Terrapin Island	Dead	Whole fish, FL 61 cm	Fresh Dead, water temp 12 C, air 2 C, load 6	Coastwise took photo	Incident and Load report
33	10 Apr 11	NAO	York Spit Channel	A	H Terrapin Island	Dead	Total Length 24.5” in, Fork Length 13.5”, Middle of anus to Anal Fin 3.8”	During Clean up. Torn in half, only posterior from pectoral region to tail, no head. Fins and tail torn but complete		Hopper daily report from, QCR, e-mail, incident report, daily report, load sheets

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
34	11Apr 11	NAO	York Spit Channel	A	H Liberty Island	Dead		During cleanup. Another piece taken on 4/13/11 matches perfectly.	Y	E-mail
35	14 Mar 12	SAC	Charleston Harbor Channel	A	H Glenn Edwards	Dead	Fresh dead, body part 26”-30” long X 13” width, no head or tail	Load 129 (0024-0345) found in starboard draghead, during cleanup mode. Given to South Carolina DNR	Yes	E-mail, load sheet, incident report
NT	25 May 05	NAO	York Spit Channel	?	H *McFarland*	Dead	Approx. 2 ft estimate from photos	Too decomposed to identify	Yes (We Have e-file)	Observer final report, REMSA 2004
NDNEF	26 Jun 96	NAN	East Rock Away Long Island	?	H Dodge Island	Dead	(~3'), couldn't identify and doesn't mention condition (fresh or dead already)? Chris Starbird.	Load sheet states Carp or sturgeon	No	Load sheet, Daily and Weekly Summary mentions. No way to confirm.
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	P *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	C	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAJ or SAS	Kings Bay	A	H *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 52 Chris Slay pers com

Sp=sturgeon species
A=Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*)
S=Shortnose sturgeon (*Acipenser brevirostrum*)

G=Gulf sturgeon (*Acipenser oxyrhynchus desotoi*)
NT = Non-take incident by dredge
SAC=Charleston

SAW=Wilmington
SAS=Savannah
SAJ=Jacksonville
SAM=Mobile
NAE=New England
NAO=Norfolk
NAN=New York
NAP=Philadelphia
H=Hopper
P=Hydraulic Cutterhead pipeline
C=Mechanical clamshell or bucket, bucket and barge
DMA=Dredged material disposal area
NDNEF=No documentation, no evidence found to confirm citation